2s 6d or 45 cents net
Annual Subscription £1 12s or $5·00 Post Free

THE INTERNATIONAL SUGAR·JOURNAL

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

Published at Central Chambers, The Broadway, London, W.5

Vol. LXII
No. 743

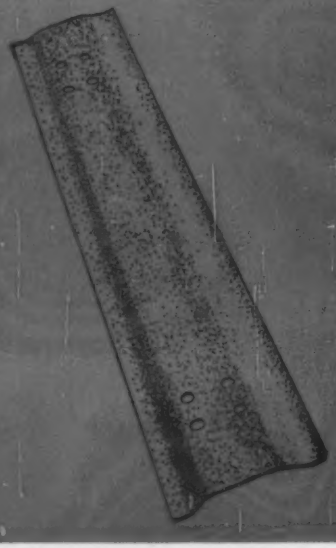
NOVEMBER, 1960

Pages
301–332

For LIST OF ADVERTISERS see page xlii

cane carrier and intermediate carrier

SLATS



Mirrlees Slats combine strength with minimum weight.

CANE CARRIER SLATS

Can be supplied, double or triple corrugated, black or galvanised, and will suit any 6 in. pitch chain and 8 in. pitch chains in the larger sizes. Where dimensions are given, slats can be supplied holed for bolts or rivets.

INTERMEDIATE CARRIER SLATS

Manufactured in designs to suit the 900 and the 3,000 series of Inter Carrier Chains. The overlap is close and slats can be supplied Black or Galvanised and holed for fixing if desired.

CHAIN & SPROCKET WHEELS

Mirrlees have exceptional experience in supplying cane and intermediate carrier chains for Sugar Mills. Full information on request.

Write for our Chains & Slats Brochure S131 – 58

Mirrlees'

THE MIRRLEES WATSON COMPANY LIMITED

Scotland Street, Glasgow, C.5.

38 Grosvenor Gardens, London, S.W.1.

SUGAR CENTRIFUGAL ASSEMBLY AND TESTING

Many customers arrange to have the centrifugal supporting structure made locally, working to Broadbent's drawings.

Centrifugals supplied to these customers are tested in our permanent test frames on the left of the photograph.

BROADBENT

THOMAS BROADBENT & SONS LTD . CENTRAL IRONWORKS . HUDDERSFIELD . ENGLAND

The World's largest manufacturer concentrating entirely on industrial centrifugals

Telephone 5520-5

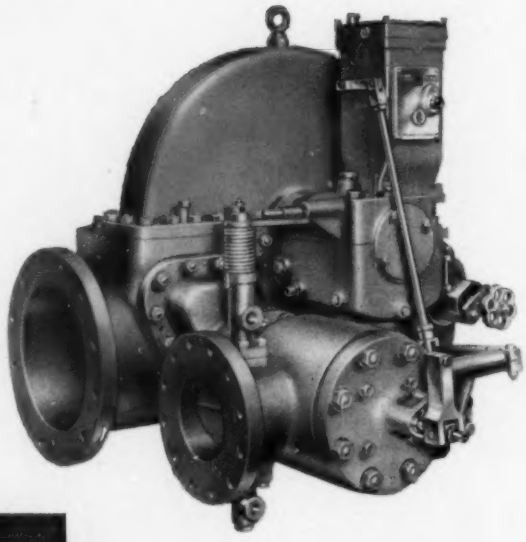
Telegrams: BROADBENT HUDDERSFIELD

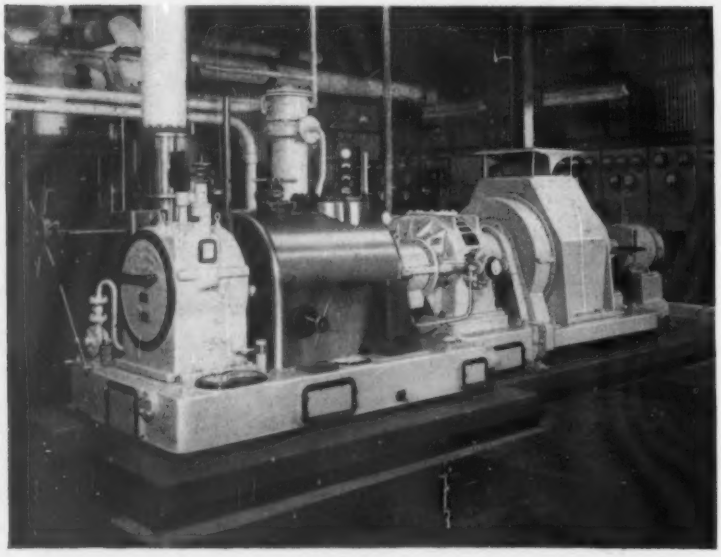
THE B & M SINGLE STAGE
SUGAR MILL TURBINE

Simple in design
Reliable and Economical
in Operation

25 to 1,200 h.p. direct coupled at speeds of up to 5,000 r.p.m. max. or supplied with reduction gearing of any desired ratio.

'B & M' single stage variable speed mechanical drive turbine, particularly adapted for SUGAR MILLS, PUMPS, etc.





750 kw back pressure turbine installed at Farleigh Sugar Mill, Queensland.

1,500 kw 'B & M' back pressure turbine and several steam engines also installed.

Many hundreds of 'B & M' Steam Turbines and Steam Engines have been supplied to the Sugar Industry for electrical and mechanical drives for:

CRUSHER
MILLS
CANE KNIVES
PUMPS ETC.

Also **VACUUM PUMPS** Reciprocating and Rotary types.
'ARCA' Pressure and Temperature REGULATORS

With the considerable resources of our up to date factory available, we are always interested in receiving enquiries for the manufacture of machinery to YOUR OWN DESIGNS.

'HAVE IT BELLISS BUILT'

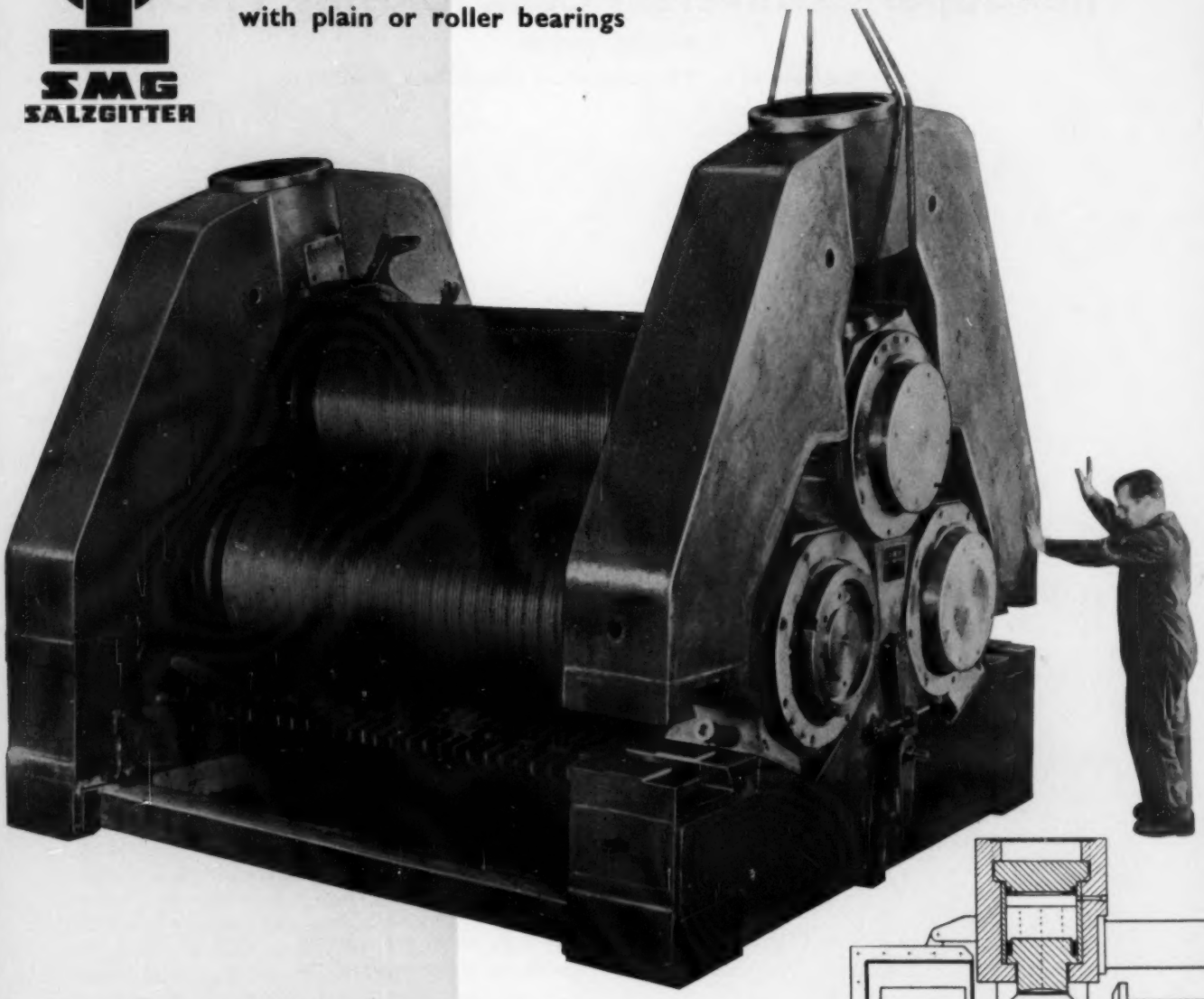
Belliss & Morcom Ltd

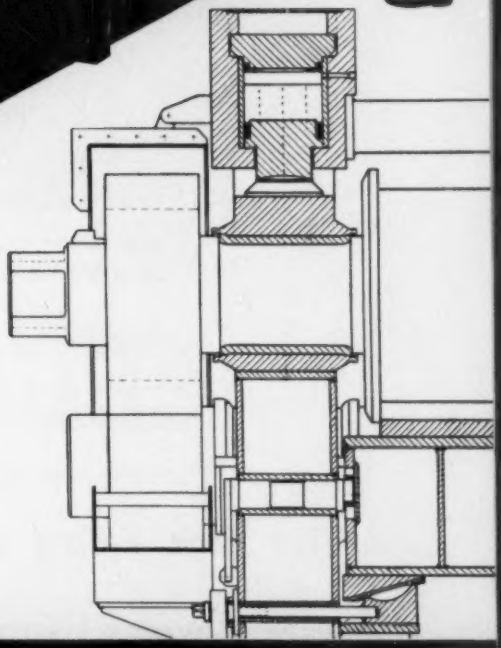
London Office:
25, Victoria Street, S.W.1.

BIRMINGHAM 16 · ENGLAND

SMG
SALZGITTER

SALZGITTER
SUGAR CANE MILLS of most modern design
with plain or roller bearings





- **The two part mill headstocks can be quickly connected and disconnected by means of a keyed joint.**
- **Mill headstocks of all-welded construction offer maximum security against fracture**
- **Long working life through efficient anti-corrosion protection of surfaces in contact with juice.**
- **The smooth inside surfaces of the mill headstocks exclude the possibility of the formation of fermentation pockets**
- **Bagasse bridge with trash plate adjustments arranged outside headstocks**
- **Tilted or vertical hydraulic head**

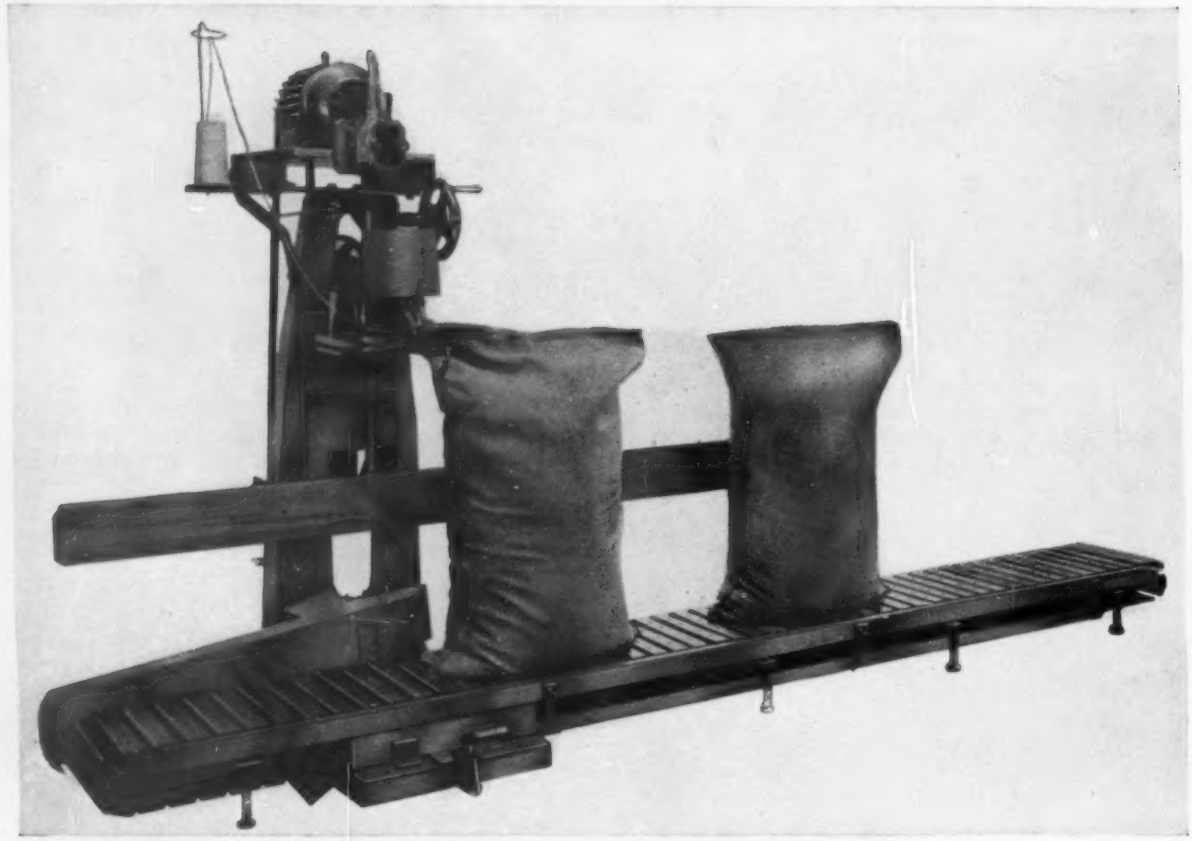
Expert advice from specialist engineers can be obtained from our technical service department.

SALZGITTER MASCHINEN AKTIENGESELLSCHAFT
SALZGITTER-BAD (Western Germany)
3441
telex: samag sgtr 0953805
samag

The 'Super' Universal Sack Closing Machine

MODEL NO. 5B

Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive



This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.

Machines can be seen working by appointment.

Power required 2 h.p. *Shipping weight : 14 cwts.*

Manufactured in Great Britain by :

The Sack Filling & Sewing Machine Syndicate Limited

(Timewell's Patent)

TIMEWELL WORKS · LOCKFIELD AVENUE · BRIMSDOWN · ENFIELD . MIDDX.

Telephone : HOWARD 1188 *Telegrams :* FECIT, ENFIELD

Farrel rubber-belt carriers

proven cleaner, more durable in installations since 1952

54 installations since 1952 have proven Farrel rubber-belt intermediate carriers definitely superior to the conventional chain and slat type. Reports from users indicate that maintenance of these simple units is almost unheard of, operation is cleaner and retention of bagasse and imbibition better.

The first of these carriers, for example, was installed at Central Plata, Puerto Rico, in 1952. It was used for 6 crops in grinding 2½ million tons of cane. According to chief engineer Rafael Labiosa, "Not a single minute has been lost due to mechanical failure of the rubber belt and the rest of the components of its units." The belt, which is still in usable condition, is now carried as a spare.

The performance of the belt is all the more amazing when you consider that it had only 1/16" rubber covering on the carrying side. Subsequent units supplied by Farrel have a 1/8" rubber coating.

Farrel's patented carrier has been designed for easy replacement of a slat carrier during a short shut-down. The endless rubber belt has rubber cleats on the top every six inches for better mill feed.

Send for a quotation covering your requirements.

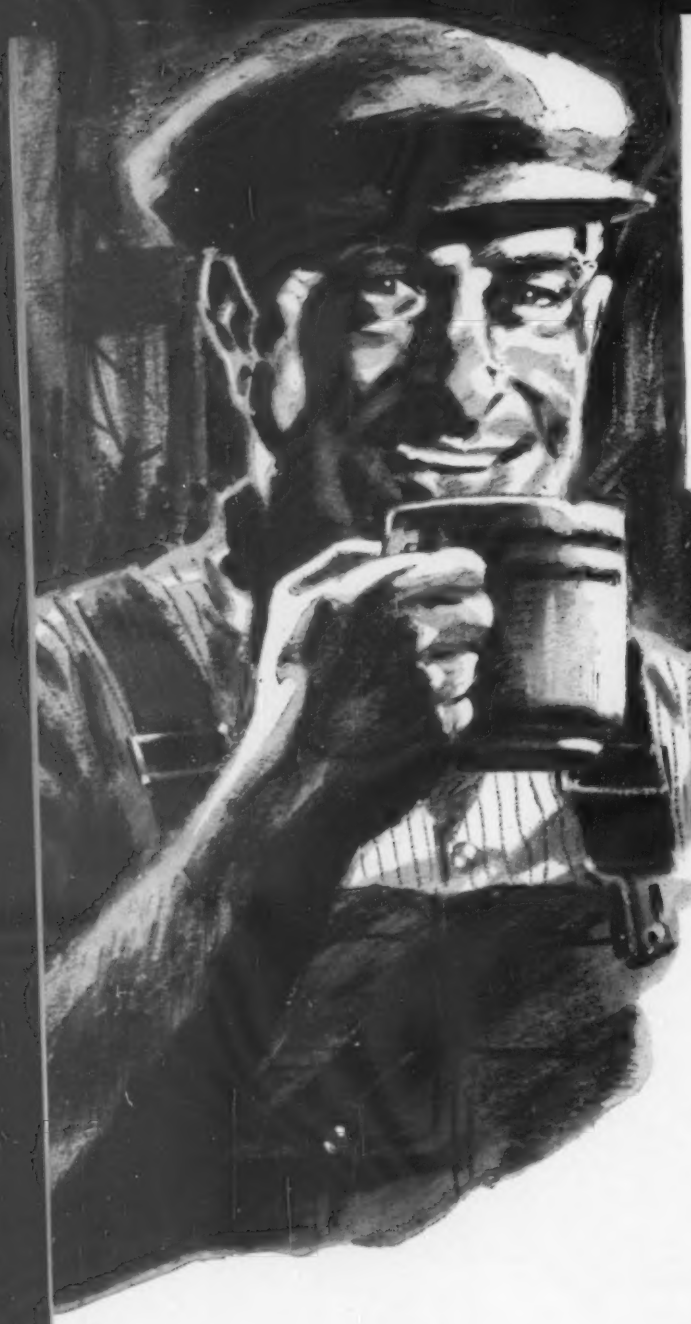
FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT, U. S. A.

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

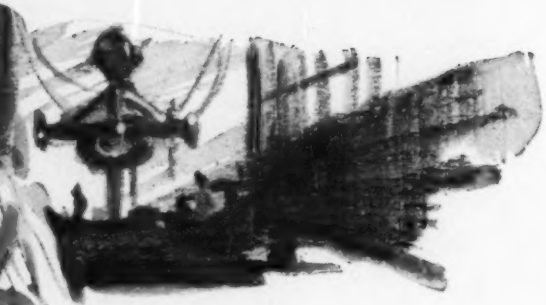
FB-1202

One of the Farrel rubber-belt carriers in operation at Central Plata, Puerto Rico.

FARREL ®



Helping to sweeten it is our cup of tea



Tea needs sugar. Sugar needs refining. Refineries need gears. Big gears, heavy gears, reliable gears. That's where the Jackson Division of David Brown comes in.

What, in particular, can David Brown offer? First, the advantages in speed and reliability of having casting, machining and cutting carried out in the same organisation. Second, the capacity to produce heavy-duty gears—spur, helical or bevel—up to any size and weight for any industry and every bit as accurately as you need. Third, the finest advice on heavy gear design problems that you will find anywhere.

Behind every 'Jackson' gear there are over 100 years of sound technical experience. In front of every 'Jackson' gear there is a long, long life of hard, hard work. And the bigger your requirements, the better David Brown can handle them.

DAVID BROWN

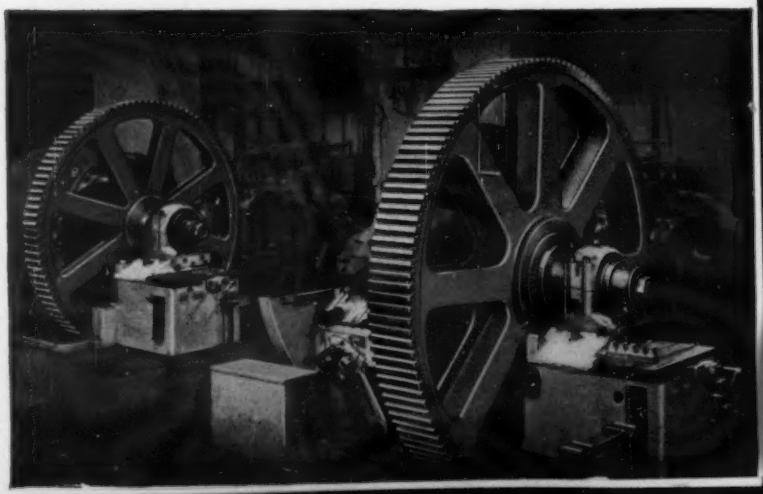
100 YEARS 1860-1960

THE DAVID BROWN CORPORATION (SALES) LIMITED

JACKSON DIVISION · SALFORD WORKS

HAMPSON STREET · MANCHESTER 5

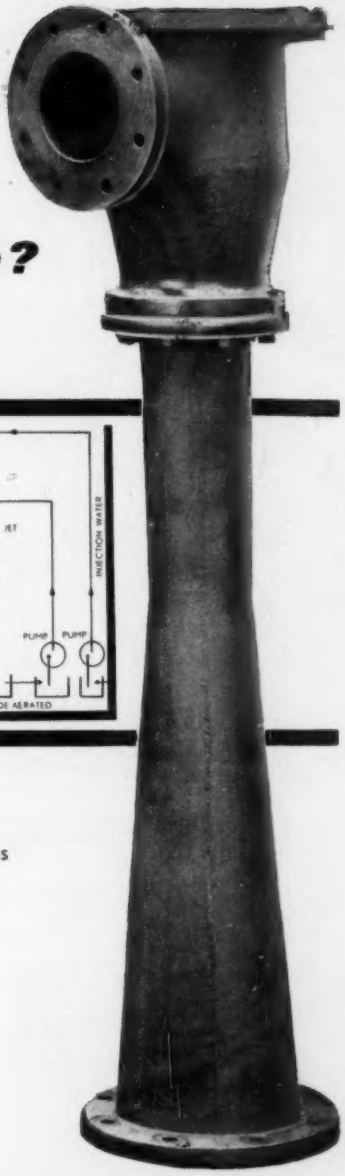
Telephone Blackfriars 3577 (4 lines)



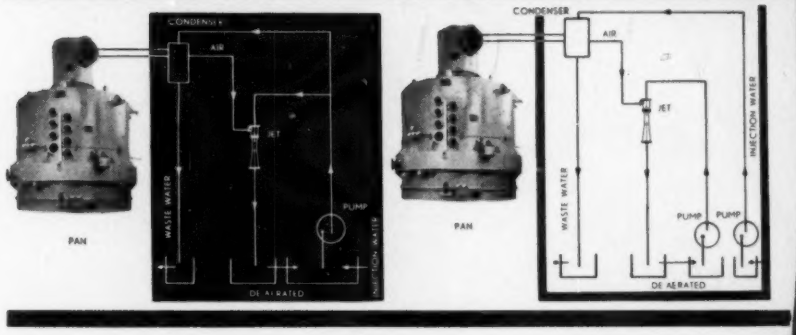
Baudouin

In this Jet-age...

why not fall in line?



SCHEMATICAL ARRANGEMENTS



Serve your Stork-Werkspoor individual Vacuum Pans
and your Stork-Werkspoor Evaporator
with Stork-Werkspoor **Water-Jet Air-Removal.**

Simple!

No moving parts! No extra water required!
Only **one** orifice, **no clogging**
of small-sized multi-jets!

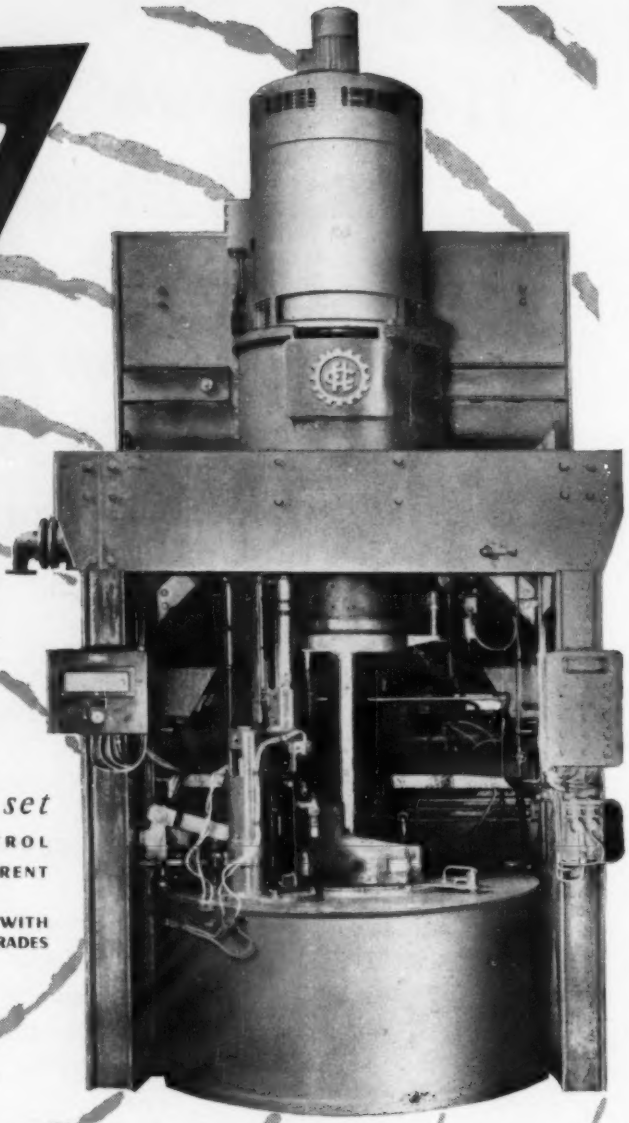
For all sugar machinery apply to Gebr. Stork & Co N.V. - Hengelo - Netherlands

STORK HENGELO (V·M·F) **WERKSPOOR** AMSTERDAM

Fully automatic!

the new

CENTRIFUGAL



driven by

WARD-LEONARD *set*

- ELECTRONIC CONTROL
- ELIMINATION OF CURRENT PEAKS
- RECORD PRODUCTION WITH MASSECUITES OF ALL GRADES

Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)

S.A.G. - PARIS

FIVES LILLE - CAIL

7, rue Montalivet, PARIS (8e) - Tél.: ANJou 22-01 et 32-40

Progressive Sugar Factories in –

MAURITIUS, AFRICA,
SOUTH AMERICA, INDIA, ETC.

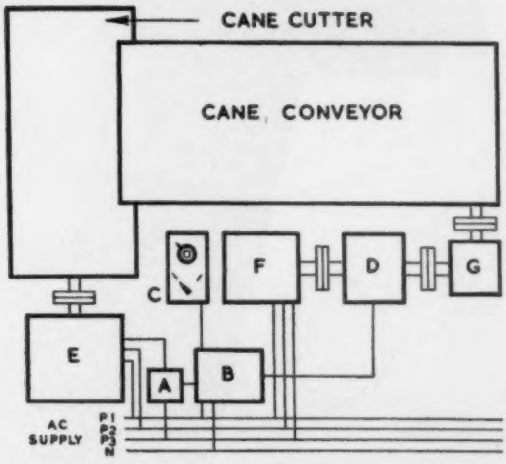
ARE INCREASING THEIR PRODUCTION BY USING

HEENAN-DYNAMATIC COUPLINGS

IN THE DRIVES TO CANE FEEDER CONVEYORS

Automatic regulation of feed ensures that cane knives are always working at peak efficiency thus achieving maximum throughput

Please send for details

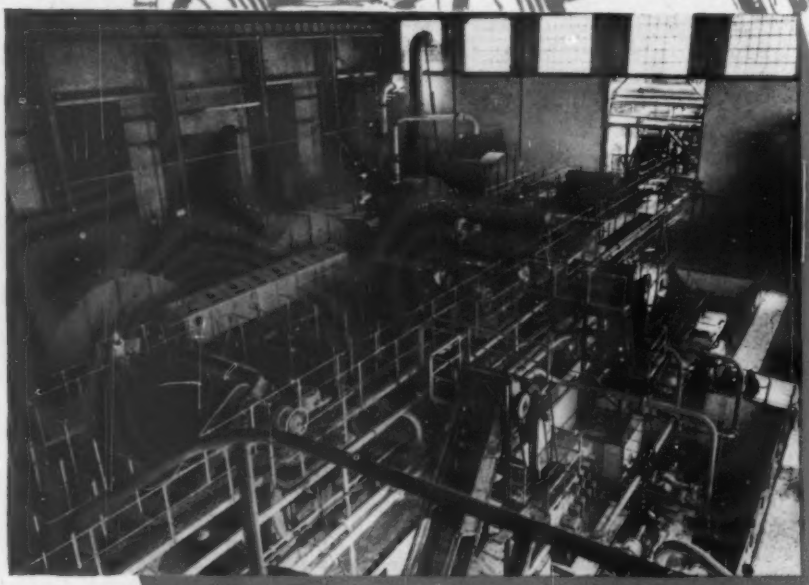


KEY TO DIAGRAM

- **A** Current transformer
- **B** Electronic excitation unit
- **C** Manual control of conveyor speed
- **D** HEENAN-DYNAMATIC COUPLING in conveyor drive
- **E** Cutter motor
- **F** Conveyor motor
- **G** Gearbox

H&F

HEENAN & FROUDE LTD., ENGINEERS, WORCESTER, ENGLAND



Complete Sugar Plants

Over a long period Czechoslovak industry has gained a reputation for installing, extending and reconstructing Cane and Beet Sugar Plants.

As a result the advanced design and high quality of Czechoslovak machinery is appreciated in hundreds of Sugar Plants and Refineries all over the world: Sugar Plants in India, China and Ceylon as well as numerous plants in U.S.S.R. being among the latest to which deliveries have been made.

In Czechoslovakia we design, build and supply equipment incorporating the latest techniques for complete Sugar Plants of all kinds and sizes.

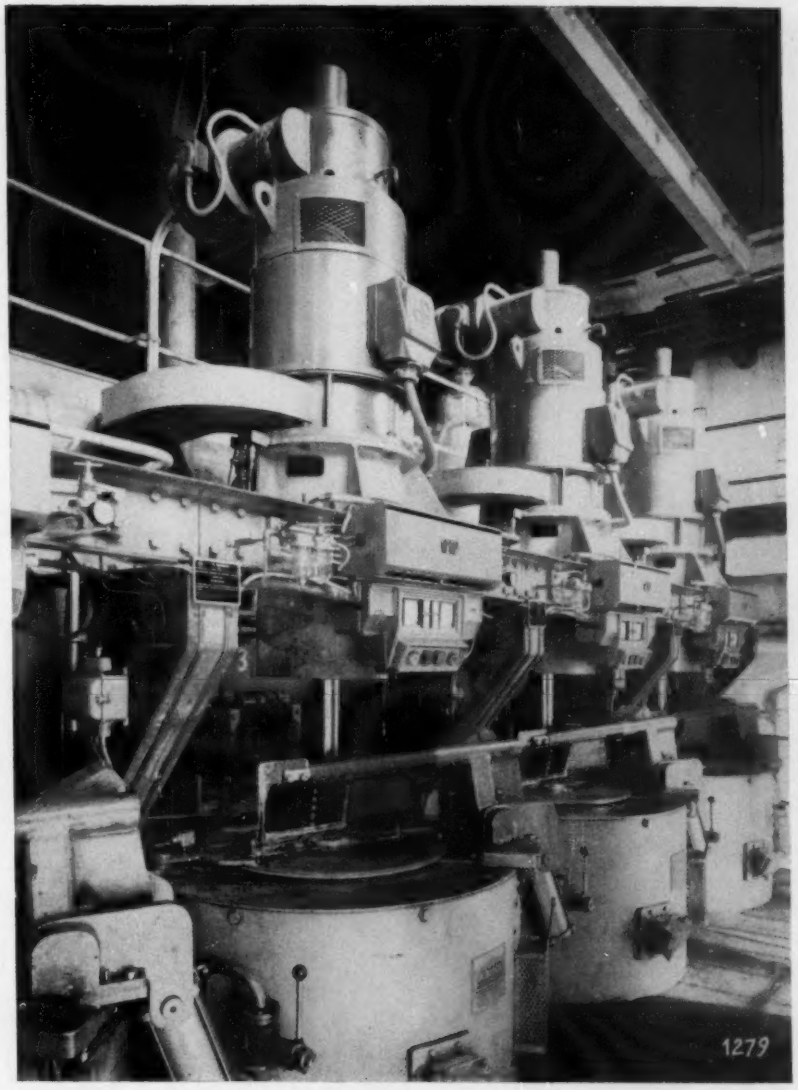
For further information write to —

TECHNOEXPORT PRAHA CZECHOSLOVAKIA

Since it was established in 1890, our Company has manufactured machinery for the sugar industry, and for more than forty years has specialized in constructing centrifugals.

Our Technical Service is continually developing machines which incorporate improvements designed to meet the technological requirements of new and varying processes in the sugar industry, taking into account the demands of the European Common Market.

These new centrifugals are distinguished for their high grade of *standardization* and for their low cost both from the point of view of the purchase price and running costs.



FULLY AUTOMATIC SUGAR CENTRIFUGALS

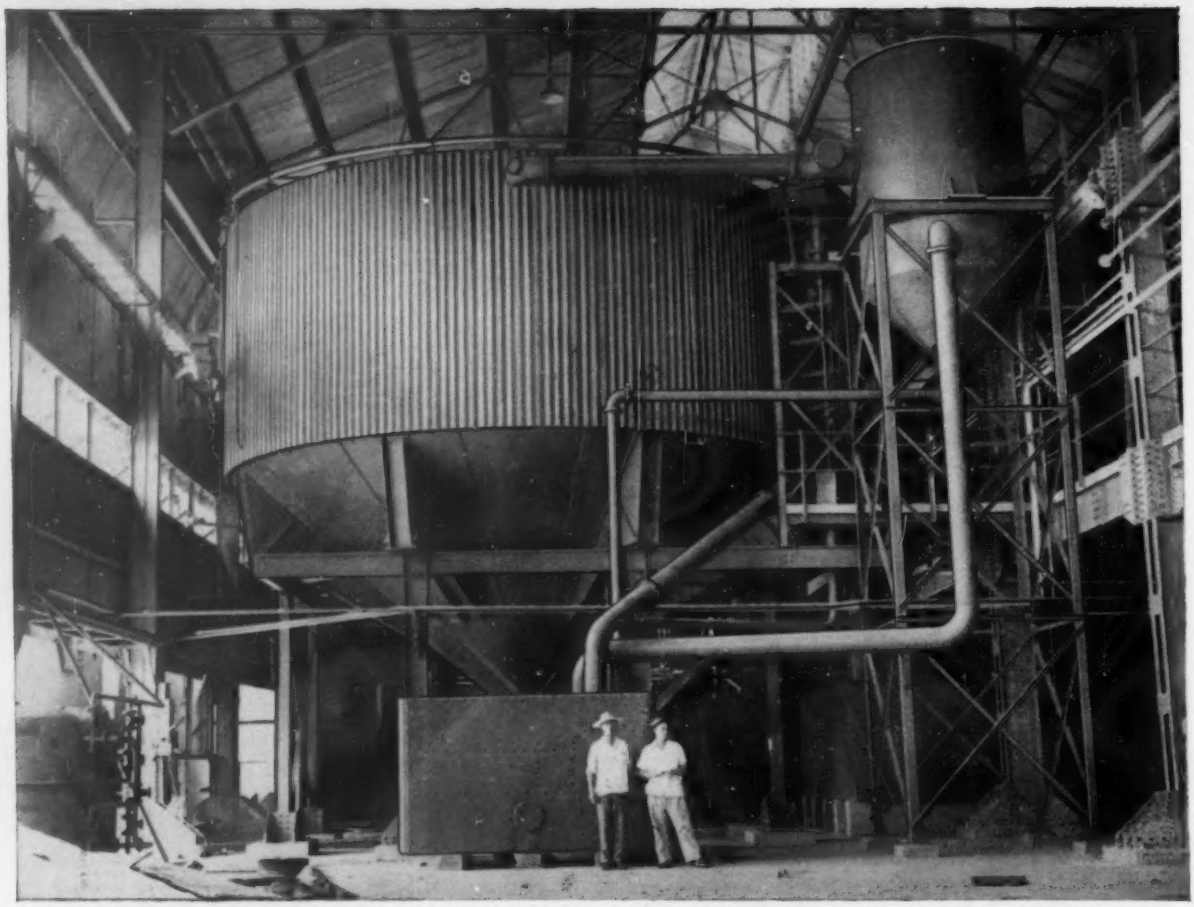
Type	*Basket D × H*	*Basket cross section*	*Massecuite Max. Charge*	*Performances*		
				Mod.	*Max. sp. r.p.m.*	*Cycles per hr.*
"SCARA. U"	1250 × 830 mm.	Cylindrical with truncated cone shaped bottom	500 kg.	Normal	1000	30
				Velox	1500	25
"SCAME. P"	1050 × 585 mm.	Cylindrical with flat bottom	350 kg	Normal	1500	20
				Velox	1800	10
"SCAME. G"	1220 × 762 mm.	Cylindrical with flat bottom	650 kg.	Normal	1000	25
				Velox	1500	20

BOSCO TERNI

Officine Meccaniche e Fonderie

A. BOSCO

TERNI ITALY



'Mirrlees'

BACH CONTINUOUS SUBSIDERS

Illustrated is one of our most recent installations, a 30 feet, 5 tray Subsider in operation in Venezuela.

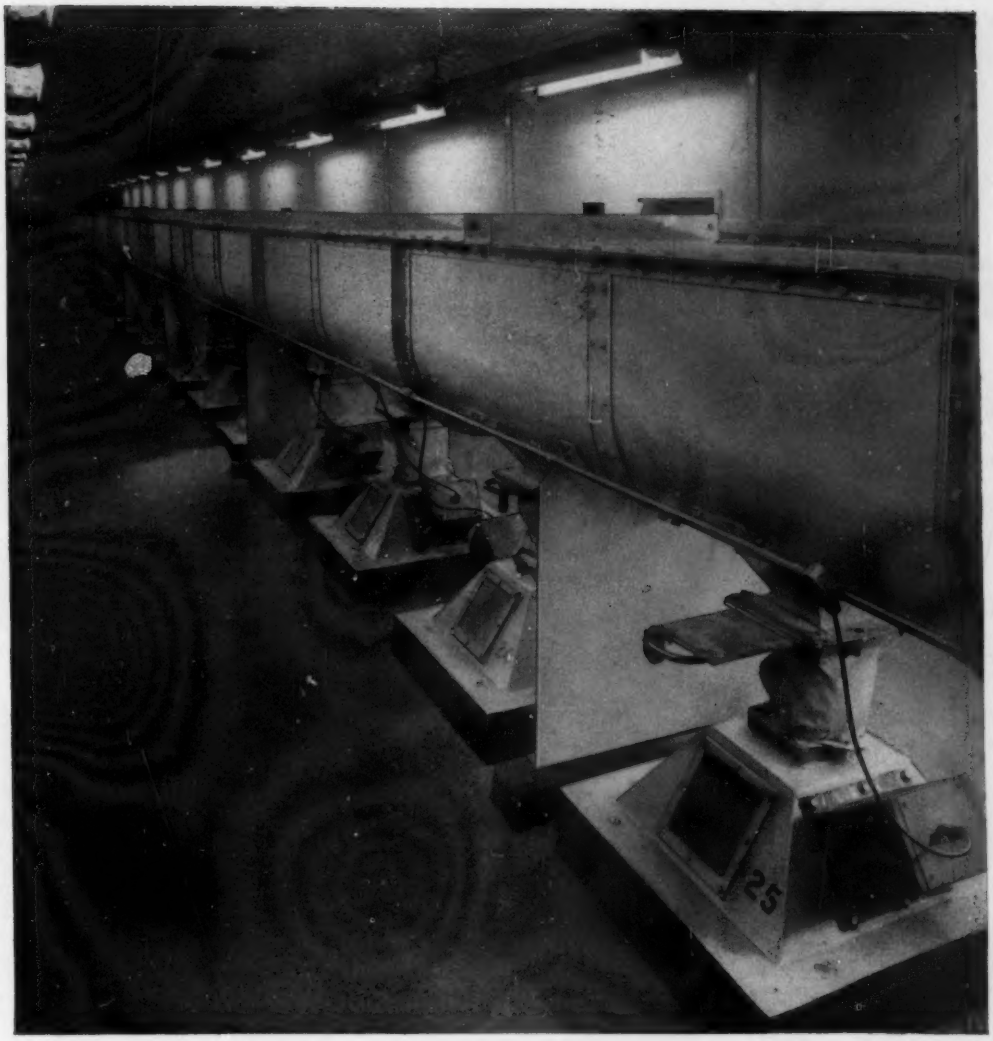
This Subsider enables juice to be drawn off at 5 points of optimum clarity. Surface evaporation is obviated, no surface scum enters the tank, and a high temperature is maintained throughout the apparatus.

SEALED 'Mirrlees' 'Bach' CLARIFICATION

The MIRRLEES WATSON COMPANY LIMITED

SCOTLAND STREET GLASGOW, C.5

London Office: 38 GROSVENOR GARDENS, S.W.1



SUGAR HANDLING PLANT by

NEWCON

Manufacturers of all types of
MECHANICAL HANDLING EQUIPMENT—
including BELT CONVEYORS, ELEVATORS,
SCREW CONVEYORS, VIBRATING CONVEYORS.

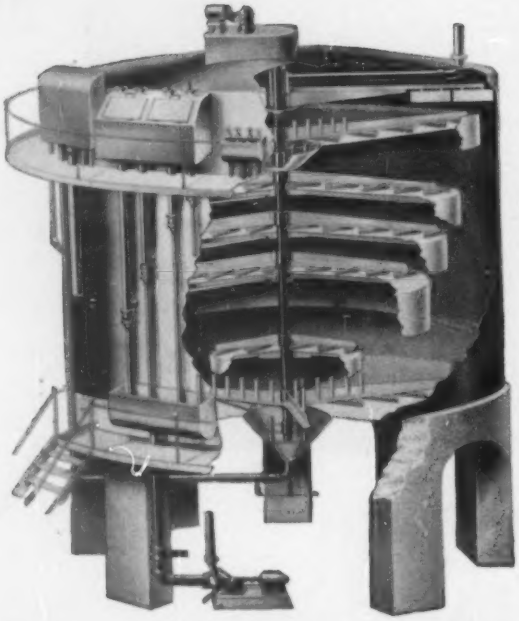
NEW CONVEYOR COMPANY LIMITED

A COMPANY

HEAD OFFICE: SMETHWICK, BIRMINGHAM 40
BRANCHES IN LONDON AND MANCHESTER

Presenting

GRAVER PRIMA-SEP CLARIFIER



AN ADVANCED CONCEPT IN SUGAR CLARIFICATION WITH THESE ADVANTAGES

Primary Separation and Mud Removal — up to 60% of incoming juice impurities are removed by new primary tray and sump, leading to better, faster settling in entire unit.

25% Increased Capacity—faster throughout and shorter retention time, due to improved "free-fall" sedimentation, increase capacity 25%.

Complete "Free-Fall" Settling—Prima-Sep has new large peripheral "free-fall" settling area where solids settle more rapidly and completely because they are unhindered. More solids than ever before are removed, including finest bagacillo, and juice is sparkling clear. New method means hybrid canes can be treated as easily as native canes and mechanized processing can be used wherever desired.

Greater Mud Thickening—new mud pickets on the primary and final mud removal scrapers, and separate pickets in the sumps, provide maximum mud thickening, low filtrate return.

Process Economy — greater and faster clarification at all solids and viscosity levels means less time and expense in harvesting, washing and processing canes . . . greater yield of raw sugar . . . reduced requirements for maceration water, steam, evaporator pan and vacuum filters . . . absolute minimum of inversion.

. . . . . .

Based on the most modern principles of sugar clarification, improved Prima-Sep design is backed by Graver's world-wide sugar experience of over 20 years. These new features bring you the greatest economy and clarification at the highest rate while maintaining the advantages and efficiency of multi-tray design.

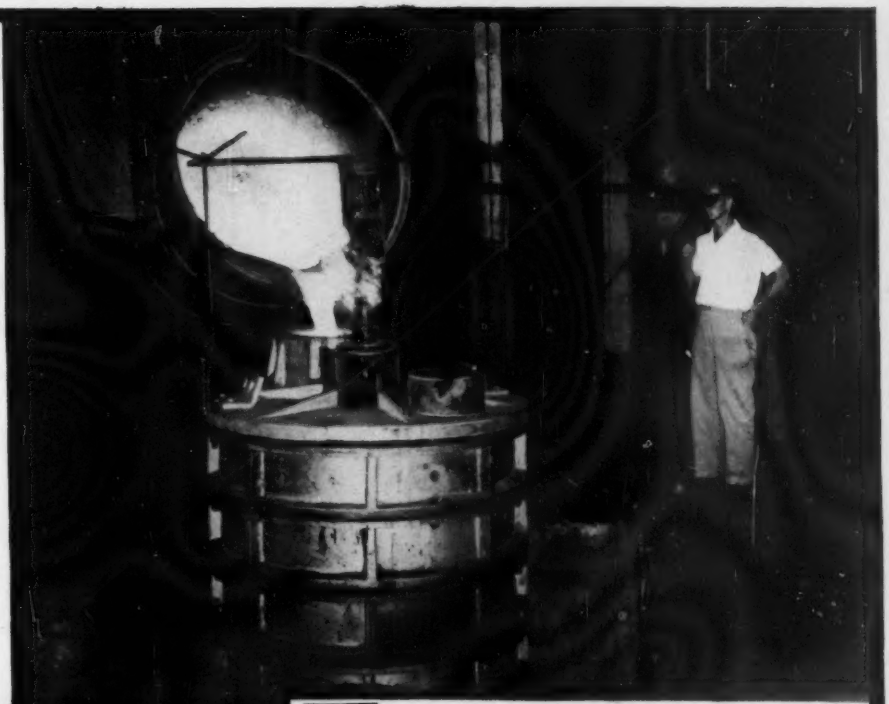
REQUEST NEW BULLETIN WC-125

MECHANS LIMITED

IN ASSOCIATION WITH
GRAVER WATER CONDITIONING CO.

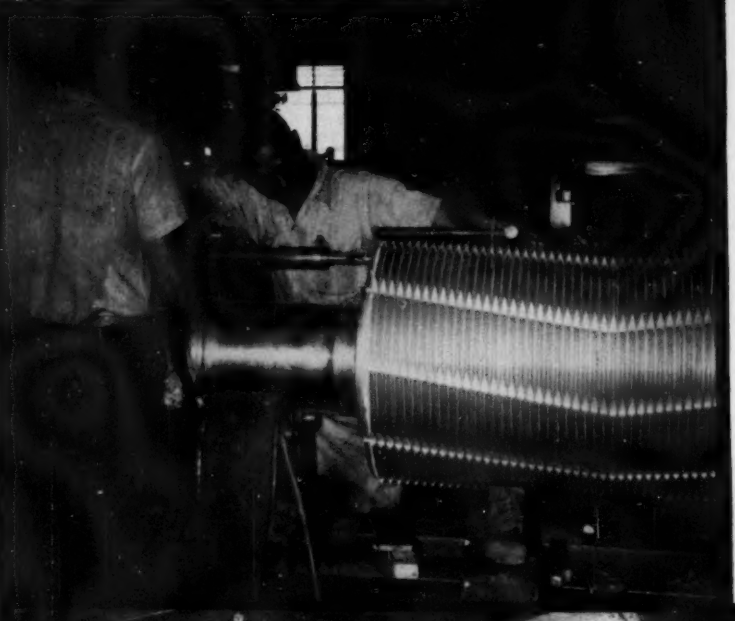
Scotstoun Iron Works, Glasgow, W.4

Service & durability are built into a K. I. W. ROLLER



Pouring molten metal into a roller mould in our Foundry.

- Casting under expert supervision.
- Quality control throughout entire process.
- Open grain.
- Shafts of highest grade steel.
- Precision built.



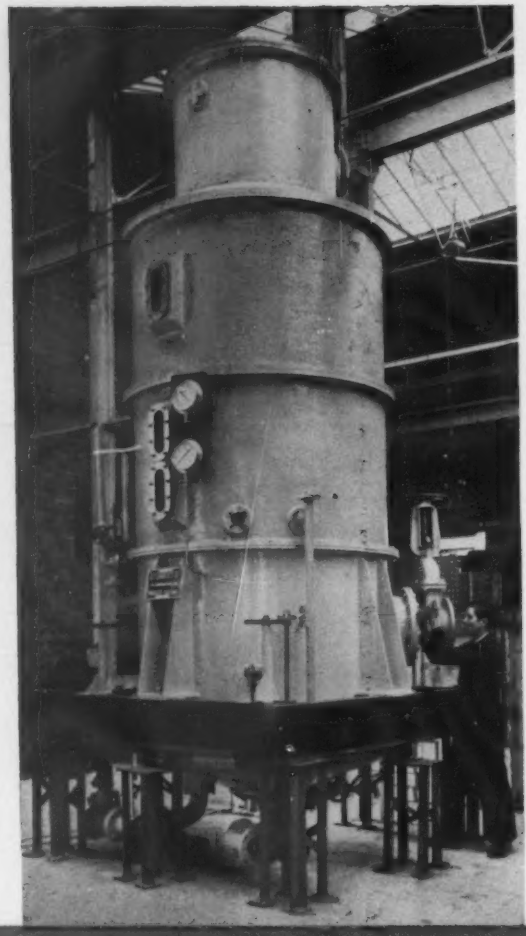
Drilling bolt holes for the roller flanges.

KINGSTON INDUSTRIAL WORKS LTD.

Spanish Town Rd.

Cable
INDUSTRIAL
for
QUOTATIONS

Kingston 11. Jamaica.



Evaporators by

*CRAIG

*** manufacturers of machinery for Complete Sugar Factories**

This illustration shows a sugar factory in India. The complete mechanical equipment for this factory was supplied by Craig.

Your enquiries will have our prompt attention.

A. F. CRAIG & COMPANY LIMITED

Head Office and Works: Caledonia Engineering Works, PAISLEY, SCOTLAND
Telephone: Paisley 2191 Telegrams: Craig, Paisley
London Office: 727 Salisbury House, London Wall, E.C.2 Telephone: National 3964

International Sugar Journal

VOL. 62 *November, 1960* No. 743

Editor and Manager :
D. LEIGHTON, B.Sc., A.R.I.C.

Agricultural Editor:
H. MARTIN-LEAKE, Sc.D.

Assistant Editor:
M. G. COPE, A.I.L.(*Rus.*)

Panel of Referees

L. D. BAVER,
Director, Experiment Station, Hawaiian Sugar Planters' Association.

A. CARRUTHERS,
Director of Research, British Sugar Corporation Ltd.

F. M. CHAPMAN,
Technical Adviser, Tate & Lyle Ltd.

J. EISNER,
Technical Adviser, Booker Bros. McConnell & Co. Ltd.

P. HONIG,
Consulting Sugar Technologist.

J. CAMPBELL MACDONALD,
Chief Technical Officer, British Sugar Corporation Ltd.

H. C. S. DE WHALLEY,
Consultant, Tate & Lyle Ltd.

O. WIKLUND,
Swedish Sugar Corporation.

* * *

Published by
The International Sugar Journal Ltd.
Central Chambers, The Broadway,
London, W.5.
Telephone : EALing 1535
Cable : Sugaphilos, London.

* * *

Annual Subscription: 32s. 0d. or $5.00 post free
Single Copies: 2s 6d or 45 cents post free

PAGE

Notes and Comments 301
European beet sugar estimates. The London terminal market. U.S. authorization of San Domingo imports. U.K. Sugar Board report, 1959/60. International Sugar Agreement surrender redistribution. U.S. sugar supplies in 1961.

* * *

Agricultural Articles:

An Experience in Agricultural Partnership .. 303

The Sugar Cane in Puerto Rico 306

Agricultural Abstracts 305-6

* * *

General Articles:

Sugar Crystallization in Thin Films 307
By H. E. C. Powers.

An Abnormal Constituent of the Ash Content of Beet Sugar Factory Products (Part I.) 313
Experiences in some B.S.C. factories in recent campaigns.
By William H. Parker, M.B.E., M.Sc.

Recommendations of the Pakistan Sugar Commission 318
By Dr. H. Kampf, Dr.Tech.Sc., F.R.I.C.

* * *

Sugar-House Practice 320
Bulk sugar handling at the Biscom (Binalbagan-Isabela Sugar Co. Inc). Scoring the performances of Philippine sugar factories. Sugar house equipment performances in the Philippines. Recent improvement at the San Carlos sugar factory *etc.*

Beet Factory Notes 322
Separation of the flock from prelimed beet juices. Juice composition in relation to factory performance. Methods of waste water treatment. Legal aspects and physical treatment. Ion exchange in the sugar industry. Control engineering applied to the British Sugar Corporation. Optimum campaign length *etc.*

New Books and Bulletins 325
Sugar Cane Nutrition and Culture. Fertilizers in the Commonwealth, 1950-1958. Proceedings of the Sixteenth Annual Convention of the Deccan Sugar Technologists' Association (India), 1959 *etc.*

Laboratory Methods and Chemical Reports 326
Rapid method for mass determination of the marc content in beet. The dependence of sugar decomposition rate on temperature above 100°C *etc.*

By-Products 328
Drying of green fodder, beet leaves and potatoes—an economically important by-product of the sugar industry. Bond and wrapping papers from sugar cane bagasse *etc.*

Patents 329
Lubricants containing fatty acid esters of saccharides. Rapid soda process for pulping bagasse. Certain oxyalkylated sucroses and method of making same *etc.*

Trade Notices 330
Mark 6 portable "Deminrolit" unit. High-pressure flow indicators and alarms *etc.*

European Beet Sugar Production Estimates 331

Indonesian Sugar Exports, 1957/59 332

Stock Exchange Quotations 332

Brevities 331-2

Index to Advertisers xlii

Water Powered Centrifugals

WITH FLEXIBLE CONTROL FOR ALL GRADES OF SUGAR

Watson Laidlaw Water-Driven centrifugals are designed for consistent reliability and for ease of maintenance . . . no high degree of skill is required for normal upkeep and repairs.

Our "Super" High-Speed Water-Driven centrifugals can easily be adjusted to run at varying speeds, to suit the grade of sugar being treated.

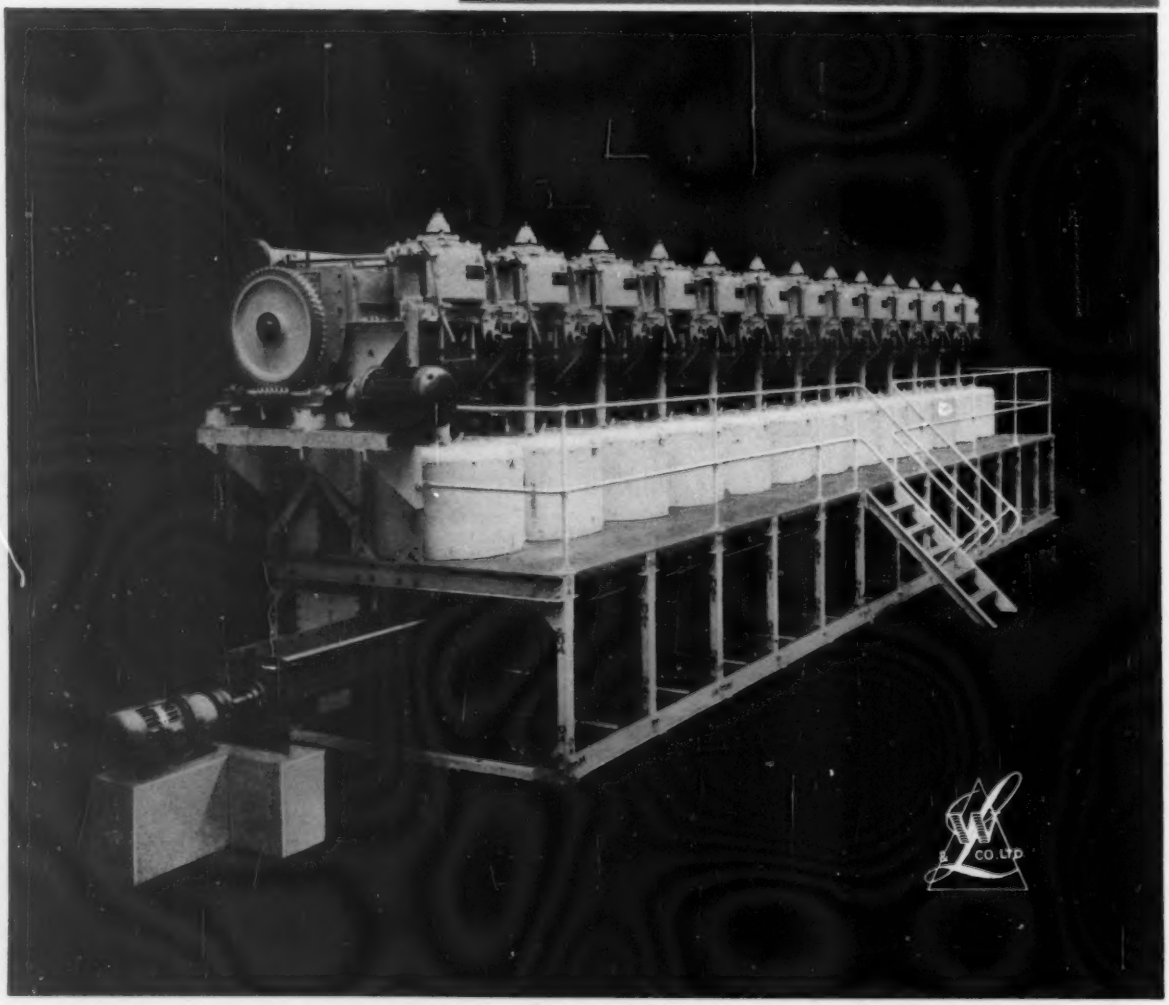
WATSON LAIDLAW
AND COMPANY LIMITED

Designers and Manufacturers of Modern Centrifugal Machines

98 LAIDLAW ST., GLASGOW, C.5.

Telephone: SOUth. 2543 Telegrams: "FUGAL" Glasgow.

Illustration shows 13—36" × 18" water-driven centrifugals recently erected in our workshop prior to despatch to a sugar factory in Pakistan.



THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXII NOVEMBER, 1960 No. 743

NOTES AND COMMENTS

European beet sugar estimates.

The European beet sugar crop is about a third of the sugar produced in the world, and consequently at this time it is one of the most important factors affecting sugar. Consequently the first estimates of the 1960/61 crop, published recently by F. O. LICHT K.G.[1] are of extreme interest. These figures, with comparative data for earlier years supplied by C. Czarnikow Ltd., appear elsewhere in this issue. The anticipated increase in total output is more than 3·5 million tons, of which nearly a third is indicated for France where a crop of 2·2 million tons is expected—more than double the crop of 1959/60 which was affected by drought. The second third is anticipated in a million ton increase from the U.S.S.R. while the remainder is spread among the other countries of Europe with the exception of Austria and Italy where substantial reductions have been made in beet area.

* * *

The London terminal market.[2]

Far from suffering from the present unsettled conditions in the world sugar market the London Terminal Market may fairly be said to have drawn added strength and stature from these very circumstances. With the final liquidation of the last remaining contracts open on the original non-Preferential delivery basis, the market has been able to concentrate on the revised contract which, although based on delivery c.i.f. U.K. of sugar produced within the Commonwealth, nevertheless is in no way limited in value to those trading within that field, but does indeed accurately reflect world sentiment.

Whilst tenders of actual sugar since trading commenced in the new contract in October 1959 have been negligible, amounting to well under 1% of the turnover, one must in considering any futures market always keep in mind the broadness and soundness of the trade in the actual commodity on which it is founded. In the present case actual shipments to this country of sugar of Commonwealth origin are in the region of some 1,700,000 tons each year, all of which—in spite of the Commonwealth negotiated price arrangements with producers—is in fact purchased by refiners and other users in the U.K. at world market prices. Supplies are readily available through the medium either of the Sugar Board or of the producers themselves; in addition to the U.K. refiners who give priority under a long standing agreement to Commonwealth raws offered to them on the world market price basis, buyers of such sugar are to be found among the many manufacturers in this country who are able to use raws in their processes.

Thus it can be seen that the present London Terminal contract has as a foundation a wide and solidly based trade in raw sugar emanating within the Commonwealth Sugar Agreement from areas sufficiently well dispersed throughout the world to render the flow of supplies as a whole relatively immune to local disturbances of a climatic or political nature.

Comparison is inevitable in a discussion on such a topic, and one cannot fail to observe, that in the New York No. 4 Market the open interest, which one has been accustomed to find within the 350,000 to 450,000 tons bracket, has now dwindled to a mere 160,000 tons, that the daily turnover, long averaging 20,000 to 30,000 tons or more, has now dropped well below 10,000 tons, and above all, that the traded prices even in the nearer positions are some twenty points below the value of prompt sugar. One is driven to conclude that the current difficulties of that market are due to its dependence for all practical purposes on one single and at present troubled origin for the supplies of actual sugar. Recognition of this fact is seen in the discussions now taking place among the members of the New York Coffee and Sugar Exchange with a view to establishing a new contract, the No. 8 Contract, which it is understood will be based on delivery f.o.b. and stowed of raw sugar from a number of countries in Central and South America and the Caribbean.

The London market has had many difficulties to overcome since it was reopened in 1957 and little of its pre-war experience was still of value in the changed circumstances. Nevertheless, with its sound basis of daily transactions in actual sugar, with its open

[1] *International Sugar Report*, 1960, **92**, (Supp. 18), 214.
[2] C. Czarnikow Ltd., *Sugar Review*, 1960, (472), 151.

interest of over 100,000 tons and with the last published figures showing an average daily turnover of some 7500 tons, it is felt that this market now provides a dependable medium of operation for the sugar trade throughout the world seeking price cover for its actual sugar sales or supplies.

* * *

U.S. authorization of San Domingo imports.

On the 23rd September 1960 permission was granted for the release of the Dominican Republic's additional quota of 321,857 short tons. This ended a period of uncertainty during which the quota had been withheld by the U.S. Departments of Agriculture and State, when holders had been unable to sell their sugar in the U.S. market but unwilling to sell elsewhere. However, the sellers of San Domingo sugar will not gain the differential between the U.S. price and the world free market price since the U.S. Government has stipulated that 2·00 cents must be paid per pound of this sugar in addition to the 0·625 cents duty collected by the U.S. Customs on entry. The Washington announcement also indicated that if the U.S.D.A. found that the sugar was not made readily available or not in sufficient volume it would reallocate the sugar elsewhere. C. Czarnikow comment[1], however, that "this move will not bring about an immediate increase of 322,000 tons to supplies for the U.S. market. It is estimated that total available stocks do not exceed 165,000 tons and whilst additional supplies may well be made available from the new crop these will not be forthcoming until the end of the year".

* * *

U.K. Sugar Board report, 1959/60.

On the 20th September, the Minister of Agriculture, Fisheries and Food presented his report for the year ended 30th June 1960 to the Government. During this period the Surcharge remained unchanged at the rate of 1¾d a lb (refined basis) which was fixed in January 1959. World market prices during the year were generally depressed, and averaged 2·97 cents a lb f.a.s. Cuba compared with 3·25 cents for the Board's previous financial year. The recent recovery in world prices did not, in fact, take place until after the end of the Board's financial year.

The result of the Board's transactions during the year can be summarized as follows:

(a) net outgoings of about £27¾ million on the purchase (at prices negotiated by H.M. Government) and resale (at world prices) of nearly 1·7 million tons of Commonwealth sugar costing £74 million, and of about £11¾ million in respect of the production of just over 800,000 tons of sugar by the British Sugar Corporation Ltd.

(b) net receipts of about £39½ million in respect of Surcharge collected during the year; and

(c) a deficit of some £191,000 after charging interest and expenses.

This under-recovery follows a surplus of £717,000 last year. The accumulated under-recovery of £7·1 million carried forward to the next accounting period is well within the £25 million which the Sugar Act authorises the Board to borrow in order to avoid the necessity of making frequent changes in Surcharge to match the fluctuations in world free market prices.

* * *

International Sugar Agreement surrender redistribution.

A total quantity of 457,022 metric tons, surrendered under the terms of Article 11(2) of the International Sugar Agreement, was re-distributed on the 5th October 1960. Details of the surrenders, redistribution and quotas in effect following the redistribution are given below:

Country	*Quotas in effect prior to the surrenders*	*Surrenders*	*Redistribution of 457,022 metric tons raw value*	*Adjusted quotas in effect**
Belgium	0			0
Brazil	678,062		80,954	759,016
China (Taiwan)	987,022	—87,022		900,000
Cuba	3,340,474		355,461	3,695,935
Czechoslovakia	189,832			189,832
Denmark	29,046			29,046
Dominican Republic	865,567	—140,000		725,567
France	0			0
Haiti	6,000			6,000
Hungary	46,242		5,888	52,130
Indonesia	50,000			50,000
Italy	0			0
Mexico	91,954		11,039	102,993
Netherlands	0			0
Peru	470,000	—230,000		240,000
Philippines	54,401		3,680	58,081
Poland	50,000			50,000
Portugal	0			0
U.S.S.R.	0			0
Total	6,858,600	457,022	457,022	6,858,600

* Increases of quotas in effect by the amounts redistributed are provisional pending confirmation by the countries concerned that they are in a position to accept them.

* * *

U.S. sugar supplies in 1961.

Unless there is a sharp improvement in United States—Cuban relationships, the United States may get little or no sugar from Cuba in 1961, according to Lamborn & Company, Inc. Based upon a survey made by these international sugar brokers, ample and adequate supplies of raw sugar are available for the United States in 1961, from sources other than Cuba.

Ordinarily in the past the United States has secured about one-half of its raw sugar requirements, or approximately one-third of its total requirements from Cuba. The United States consumes about 9,300,000 tons of sugar yearly and, in 1961, according to the Lamborn survey almost 5,000,000 tons of sugar can be secured from domestic areas, 4,000,000 tons from foreign countries having quotas under the Sugar Act, and 1,500,000 tons from countries at present having no quotas under the Sugar Act.

[1] *Sugar Review*, 1960, (476), 167.

AN EXPERIENCE IN AGRICULTURAL PARTNERSHIP

As the world has developed, the conduct of the cultural operations involved in agriculture has passed through evolutionary processes taking many forms. The simple peasant, cultivating his individual plot, generally part of the tribal land, has given place to a peasant hardly less simple but with personal, heritable ownership, and in many countries such systems will prevail. In other countries, often as the result of conquest, an over-lord, or landlord has arisen, living on his rents and taking no active part in the economic development of his estate. Both systems of peasantry, whether of owners or tenants, are capable of developing a subsistence type of agriculture only and, in this modern world, a type which is quite unsatisfactory, for not only does the world require an excess production to feed its urban population but an urge has arisen among the peasantry itself for a higher standard of living.

Very early, pressure came from another direction through the establishment of family estates based on the system of land-tenure known to the English, the pioneers of colonization, and characteristic of the West Indies. These required a body of labour; hence the slave trade and, since emancipation, the present system of a paid labour force unanchored to the land. In the latter half of last century, through the joint influence of the introduction of limited liability and the need for expensive processing plants, in particular the sugar central following the invention of the vacuum pan, the impersonal plantation superseded the family estate, in cases, arising from a fusion of such estates. No corresponding change, however, took place in the ownership-labour relations.

As a result of this long evolutionary process there exists at one extreme the individual peasant with a holding too small to be cultivated by modern methods even if the peasant had the financial backing to purchase the means. At the other, are the plantation and estate with every opportunity of adopting the highest standards of cultivation but increasingly subject to a threat of shortage and cost of labour led, through education and the opening up of the world, to demand an ever higher standard of living. Many intermediate stages are, of course, to be found, among them the cane-farming system of the West Indies and, more particulatly, of Trinidad. Here are plainly to be seen the relative efficiencies of the two systems with the peasant yields commonly little more than 50% of those of the directly cultivated plantation.

The plantation and peasant systems, thus, present two very different problems. The plantation system has clearly shown its capacity to "deliver the goods," but it has to be judged on a strictly financial basis and not as a philanthropic society. The two major risks from which it suffers at the present time are: first, that arising from a failure to distinguish between the long and short effects of modern practices, in turn the product of the adoption of quantity as the sole criterion of success and, second, the ever-growing cost of labour. The peasant problem is, basically, more simple, at least in definition; it is that of raising the productive capacity of the land to equality with that of the plantation; but it has proved the more intractable of the two owing to the two earlier noted disabilities: size of the unit holding and lack of finance.

Almost invariably the answer to the latter problem has been sought in co-operation and here the crucial problem was that of finance, not merely to provide the requirements for raising the fertility of the land and, where necessary, to process the product, but to reduce peasant indebtedness leading to forced sale of that product or its attachment for debt already incurred. The question here is: where, among a peasantry largely illiterate, is to be found the capacity for and the knowledge of managerial technique in its various branches? The answer is, almost invariably, the organization of co-operative societies administratively controlled by an official co-operative organization, closely linked with an agricultural department. The independent problem of the uneconomic holding, too, with the partial remedy of "re-striping", requires yet another official organization. Where, in this, is to be found that ladder by which the more intelligent may rise to form that community of independent and responsible business men and financiers without which no country can really stand on its feet? The only future for such lies in an official organization growing ever more paternalistic. How far co-operation falls short of solving the problem of peasant efficiency is indicated by the relatively small impact it has made in the decades of application in Pakistan even with the prolonged and valiant efforts of Sir MALCOLM DARLING in that country; how far it fosters paternalism—colonialism when the authority is of an alien race—is seen in the history of the Uganda Cotton Ordinances during which the Director of Agriculture has held the power, dictatorially and at the stroke of the pen, to ban the cultivation of cotton in any particular area. The further danger, too, should be apparent: by a single metamorphosis, it could become a "collective," submerging all peasant individuality.

The estate, or plantation system, with its paid labour, offers a perhaps simpler, but as intractable a problem. A paid labour force necessarily involves a degree of antipathy between management and labour; the bargaining may be conducted in a friendly spirit but at times, as under the urge for a higher standard of living, the antipathy may take a dangerous form for, even using all the most modern forms of labour-saving devices, there comes a time when the goose which lays the golden egg is killed.

Is there no way of escape from the dilemma presented by each system? More than once in the earlier pages of this Journal[1] reference has been made to a third system, most appropriately termed co-

[1] *I.S.J.*, 1948, **50**, 144 and 1959, **61**, 355.

partnership, the difference between which and co-operation, if subtle, is fundamental. Co-operation is a banding together of individually weak units which, usually through unlimited individual liability, gain a strength enabling such activities as provision of capital, bulk marketing and purchase and a loan service to members of the unit to be organized. Its weakness is dependence for technical control and guidance on an external agency not responsible to itself. It is best considered as an organization on a horizontal plane; co-partnership, on the contrary, is organization on a vertical plane, from the providers of capital down to the permanently employed labourer or tenant, sharing in its fortunes.

Unfortunately, hitherto, very little information of this last system has been generally available from which it would be possible to judge those features which are essential to success, but there has recently appeared a most informative book[2] giving the detailed history of that very successful irrigation scheme for cotton growing in the Sudan. The account is authentic since its author, A. GAITSKELL, has been associated with the scheme for 29 years, following Sir ALEXANDER MACINTYRE in 1946 as Managing Director of the Sudan Plantations Syndicate, a private body providing much of the capital and subsequently, after 1950 when the Syndicate's concession lapsed, Chairman and Managing Director of the Sudan Gezira Board. Attention was drawn to the possibility of irrigating the Gezira, that tract between the Blue and White Niles, from the former river by Sir WILLIAM GARSTIN at the beginning of the century and implementation of the scheme resulted from the forceful backing of Lord KITCHENER. Tentative trials to test the agricultural possibilities started in 1911 with the installation of a pumping plant irrigating 600 acres. From those small beginnings, the area covered now extends to some 1,000,000 feddans with a prospective extension to 1·8m feddans[3] when a further dam has been built at Rosieres.

From the aspect of the present discussion, greatest interest lies in the arguments concerning the basic system under which the land should be cultivated. Maximum efficiency in the distribution of water demanded that the cultural system should be strictly controlled, a control most readily effected by the plantation system. But there were other considerations, not the least being that, in a devastated country like the Sudan after the ravages of the Mahdi and with no resources other than agricultural, finance for rehabilitation of the people must come from the land. The full plantation system was ruled out and a partnership system was adopted under which Government, as financing the dam and major canals, the Syndicate, as its agent responsible for minor canalization, all cultural planning and the handling and selling of the crop, and the tenant cultivator shared the gross profits being distributed in the proportions of 40% each to Government and tenant and 20% to the Syndicate. It is of passing interest to note that the adoption of this partnership system resulted from the casual mention of the local crop-sharing system by W. A. DAVIE, of the Sudan Agricultural Department, which came to the ears of Lord Kitchener in 1912 and which must have synchronized with the independent discussions taking place in India, for it was in 1914 that was initiated the "zamindari" (landlord) course at the Cawnpur Agricultural College, the key feature of which was a partnership between the "zamindar" and tenant from which it was hoped the "zamindar's" capital might find employment in developing his estate to the benefit of both parties. Unfortunately, the initial success of the course was marred after the war by the diversion of interest to the political field and the promise was ultimately shattered when, after independence, the whole "zamindari" system was abolished[4].

The success of the Gezira scheme is due to no single cause, but there can be no doubt that the two major factors were the adoption from the beginning of the partnership principle and its application on a small scale on the original pumping schemes. Thus was built up from a body of indigent and illiterate peasants previously dependent even for their food on a short and precarious rainy season, a still larger body of tenants whose willing acceptance of the principle enabled its application, after 1925 when the dam was completed, to be extended to the wider areas rendered irrigable after that date. Its success is shown by the fact that the partnership has survived the many vicissitudes resulting from frequent set-backs with yields ranging from 1·4 kantars minimum per feddan to 6·8 kantars[5] maximum in 1950/51, with cotton prices ranging from 5·9d to 9·6d per lb between 1930 and 1946 and thence rising to 66d per lb in 1951. Nor were these the only difficulties the scheme had to face. At its commencement, it was admittedly and necessarily paternalistic, with the Government primarily concerned with securing a revenue from the only viable source, agriculture, sufficient to enable it later to carry out its social function, basically educational. The eyes of the Syndicate were naturally, as a commercial body, focused on the financial aspect while the tenants, as they became vocal, equally naturally, sought to secure the maximum slice of the cake for themselves. The latter interest, at the moment, forms the dominant issue as it does in all emergent communities; *festina lente* is not a lesson easily learned. During the paternalistic period there has emerged a body of responsible Sudanese to whom the work of modifying the scheme to meet the rapidly changing conditions can confidently be entrusted; but there can be little doubt that the partnership will remain whatever other changes occur. As the author admits, paternalism was retained too long—conservatism is an innate fault of officialdom—but, he adds: "it was good for the Gezira that by 1950 we had got these men (highly educated Sudanese on the Gezira Board) operating with us. It was bad that we had been slow in doing so."

[2] *Gezira.* (Faber and Faber, London). Price 42s.
[3] 1 feddan = 1·038 acres.
[4] *I.S.J.*, 1959, **61**, 356.
[5] 1 kantar = 100 lb cotton or 315 lb unginned cotton.

Simazine

A new departure in weed control

One single pre-emergent application keeps young cane weed-free for months

persistent selective safe

Simazine products for weed control in sugar cane are available

in the USA and Puerto Rico through the distributors of Geigy Agricultural Chemicals, Ardsley, N.Y., as **Geigy Simazine 80 W**

in Central and South America, Cuba, Haiti, the Dominican Republic, South Africa, the Philippines and Taiwan through the local distributors of J. R. Geigy S.A., Basle (Switzerland), as **Gesatop 50 W**

in the British Commonwealth (other than Australia) through Fisons Chemicals (Export) Ltd., 95 Wigmore Street, London, W1, as **Simazine 50 W**

Suchar ACTIVATED CARBON

effectively eliminates color, taste and odor from sugar

Specifically developed for the cane sugar industry, SUCHAR activated carbon is the best way to remove colors, odors and flavors from sugar liquors.

Amazing surface area and porosity make it the most efficient carbon you can use. And since *less* SUCHAR can treat *more* sugar, it's economical, too. Actually cuts your carbon costs by 10% or more.

For many years, SUCHAR has helped the cane sugar industry produce better sugar with activated carbon, Auto and FAS-FLO* Filters and expert engineering service. We'll be pleased to help you. As a start, let us quote on your requirements.

*Reg. TM of FAS-FLO Filter Corporation, New York

SUCHAR SALES CORPORATION

CONSULTING ENGINEERS

76 Beaver Street
New York 5, N. Y.

Cable Address: "SUCHARING" N.Y.

EXCLUSIVE DISTRIBUTORS OF SUCHAR ACTIVATED CARBON FOR THE CANE SUGAR INDUSTRY

The Gezira scheme is dominantly monocultural with, thrown in, a food crop, dura (*Sorghum vulgare*), and a fodder crop; it embraces, too, a central ginning factory. These are characteristics common to the central worked on the plantation basis with a paid labour force and it is tempting to enquire whether the partnership principle is not applicable to the cane sugar industry and even to agriculture generally. To that first enquiry there is only one answer: it is not only applicable but has been proved to be so, for it is the principle adopted in the Fiji industry after 1919, when the supply of indentured Indian labour was abruptly cut off. The principle may not, however, be so readily applied, for it is one thing to build a tenantry from an illiterate, oppressed and scattered community content to have at least a guaranteed food supply; it is quite another to change over after a spirit of antipathy has already arisen. It will be interesting to follow the recent developments on these lines in British Guiana.

But large areas of cane are grown, as in northern India, on a true peasant system and here is seen in clear outline the difficulty in securing that higher fertility which is the basis of the increased production on which a higher standard of living depends. Moreover, from India, through Pakistan, the Middle and Near East, as far as the shores of the Atlantic, as also in areas of central Africa, the cultivation of cane, often associated with beet, is being initiated. In many of these territories a peasantry cultivates within a tribal or chieftain system, and in some, as Iran, the old feudal system has only very recently been abolished with no defined succeeding system. Here are vast opportunities for establishing the partnership principle; and it should be relatively simple, for it would be a dual, and not, as in the Sudan, a triple partnership consequent on the very large sum contributed by the Government for building the Senaar Dam. There would be few, if any, occasions were irrigation works beyond the capacity of the provider of finance would be necessary. To any who may contemplate the adoption of the partnership principle, the book will be an invaluable guide not only in a positive sense as defining the essential principles but, in a negative sense as showing what pitfalls to avoid.

One word more. The commercial aspect is all-important; the financial risk is worthy of a just return. To the communities who have recently secured or will shortly secure their independence, there is the problem of developing within themselves a secure financial, commercial and social structure. If, at the commencement, finance must come from without, it is in organizations based on the partnership principle that suspicion of alien attempts to secure possession of the land will be avoided. They will provide, too, the best training ground and, as experience is gained, power will be readily transferred without the friction that normally accompanies transfer at a political level. The history of the Gezira exemplifies this as does, in an industrial field, the history of Cawnpur. That latter history cannot be detailed here but, very briefly, after the first world war the control of the vast industrial development there erected by British capital was transferred to Indian hands by the simple method of unification into a single Corporation with Indians holding the dominant interest, transfer of managerial functions taking place more gradually as Indians with the necessary qualifications became available. That change took place almost unnoticed, unaccompanied by political upheaval.

H. M.-L.

AGRICULTURAL ABSTRACTS

The controversial and important subject of trashing. J. WILSON. *S. African Sugar J.*, 1960, **44**, 289–295.—The problem of whether to trash or not to trash—trashing being defined as the removal of trash and green tops from the plant and leaving them in the field—is shown to be an economic one, a balance of advantages against disadvantages being summarized. The answer is likely to differ in individual cases. Increasing costs make burning the major, perhaps only, alternative; it is recommended for fertile, inherently productive lands with high water table, and for dry areas with a low erosion risk and unrestricted water supplies for irrigation. Elsewhere, covering the main sugar belt, trashing should continue.

* * *

Sugar cane insects in the Rio Turbio valley. III. The lesser pests. P. GUAGLIUMI. *Bull. Esta. Exp. Occidente* (Venezuela), 1958, (88), 26 pp.—The bulletin follows the same lines as the two previous in the series[1] and both lists and gives notes on the parasites, with their hyper-parasites, and predators.

* * *

The rotary slasher. S. O. SKINNER and I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, (Queensland), 1960, **23**, 119.—The machine here described is designed to dispose of the excess crop resulting from the introduction of restrictions on sugar production in 1958. It comprises a rotary ground plate carrying horizontal blades, and is attached to the rear of the tractor and driven from the p.t.o. It not only cuts but strips the cane, leaving it as a mulch through which ratoons can grow or which can be burnt.

* * *

Enemies of sugar cane of vegetable origin in Réunion. D. D'EMMEREZ DE CHARMOY. *Rev. Agric.* (Réunion), 1960, **60**, 12–16.—The term "enemy," as used here, covers only weeds, and that group of organisms which, with viruses, falls under the common term of disease. Pests are not included. In such cases control measures are briefly described.

[1] *I.S.J.*, 1959, **61**, 101, 260.

THE SUGAR CANE IN PUERTO RICO

Meeting of the Asociación de Técnicos Azucareros de Puerto Rico, 1959.

THE reimposition of the quota system in 1952-53 raised problems of pecular difficulty in the case of a Central largely drawing its supplies from "colonos" whose economic capacities to meet the strain of reduced incomes varied widely. The first response was to leave cane standing and to reduce cultural operations to a minimum. Such a reduced standard of cultivation was not only unsatisfactory but tended to lead to reduced fertility. In 1955, therefore, in the Central Plata, a Service for Colonos was introduced consisting of a scheme of assistance prepared in consultation with the colonos. Initially composed of a supervisor and technician with a single tractor with cultivating attachments, it now numbers 11 permanent staff with 13 tractors. The number of colonos involved in 1951-52 was 1,600. The scheme is described in some detail by G. ESTEVES.

In payment for harvesting by hand, difficulties arise in devising a system for providing an incentive for the better cutters. Payment to groups of cutters proved ineffective and the system ultimately adopted on the plantations of Antonio Roig, S. en C., is here described. Payment is individual and based on a daily time and area calculation. Relative costs during first year of trial were $0·99 per ton against $1·45 under the normal system.

Cultural Operations

Under conditions of low rainfall prevalent in certain areas of Puerto Rico, a new cultural system using a stubble shaver has advantages which include shaving at the optimum level and speed with which the land is laid out for irrigation, leading thereby to rapid and vigorous germination. It is the implement known as "Kenworth" or Hawaii system and it and its uses are described by T. SUAREZ. The method by which the same ends are achieved in Louisiana are briefly described by D. SCURANO.

The system of maintenance and repair of the machinery on the estate of Luce & Co. is described at considerable length in a series of notes following on an introductory review by W. NELTHROPP and P. H. GRAY.

The advantages of spreading fertilizers, not only N, P, K but the minor elements, by air are considerable and J. J. LANDROM *et al.* discuss these as disclosed by the addition of radio-active isotopes.

At Central Aguirre a programme of herbicidal treatment is being evolved with the objective of reducing cost of materials and labour. The present stage is described by R. ORTÍZ N.; under it 65% of the herbicide is distributed by air. N, in the relatively cheap aqueous ammonia, is also being used. The interlocking of the different herbicidal treatments with cultural operations is briefly indicated. A short note is also given by E. MEJIA on time and motion studies designed to achieve the same objective.

The economic factors influencing size of factories and length of harvest in Puerto Rico under the conditions imposed by a fixed quota are discussed by M. A. ARSUAGA R.

AGRICULTURAL ABSTRACTS

Optimum utilization of filter press muds. W. L. OWEN. *Sugar y Azúcar*, 1960, **55,** (7), 27–28, 49.—A mechanical device for composting filter-press muds is described which allows the material to be turned frequently, thus ensuring complete access to air, and which provides for aeration by air spargers on the side of the silo, for the initial inoculation with specially prepared cultures, and for the addition of a coarse ground constituent of cane trash or bagasse. The moisture content is maintained by periodic applications of water, and warm air is supplied. The advantages of mechanical composting are enumerated.

* * *

Control of the sugar cane borer with insecticides. W. H. LONG *et al. Sugar Bull.* (Louisiana), 1960, **38,** 202–206.—Further[1] evidence is given of the superior effectiveness of "Endrin" over other insecticides for the control of the borer. Four bi-weekly applications, at a cost of $10 per acre, of 2% granules at 12 lb per acre, broadcast by air, are recommended for control of second and third generations.

* * *

The effects of "Dalapon" on the microflora of mhoon soil. L. A. MAGEE *et al. Sugar Bull.* (Louisiana), 1960, **38,** 242–244.—The experiments covered single and repeated dressings of "Dalapon" ranging from 50–5000 p.p.m. The lowest concentration had little effect in single applications, but higher concentrations led to increase in the microflora. Repeated applications resulted in a marked increase in the moulds and a decrease in the bacteria and actinomycetes after the 4th application. After the 5th application increases were found in all classes of organisms, especially with the 5000 p.p.m. application.

* * *

Field practices of sugar cane culture in Taiwan. WAN-CHUN HSU. *Sugar J.* (La.), 1960, **52,** (12), 23–29.—All cultural procedures are described in some detail. These are unusually complex owing to diversity of planting seasons, September to November (early) and December to May (late) respectively, to the systems of inter-planting with rice and to the fact that production falls under two heads—direct cultivation by the Taiwan Sugar Corporation and the contract farmer. The former alone is capable of adopting mechanization.

[1] *I.S.J.*, 1959, **61,** 327.

SUGAR CRYSTALLIZATION IN THIN FILMS

By H. E. C. POWERS
(Tate & Lyle Ltd., Thames Refinery, E.16.)

Address and paper presented to the 13th Technical Conference, British Sugar Corporation, 1960

WHEN sugar technologists discuss the degree of supersaturation at which crystallization is carried out, they rarely refer to anything above 1·3. This is understandable, for almost automatically they are thinking only of crystallization as carried out in the vacuum pan.

Granulation has traditionally been regarded as a drying operation, whereas it is also, and should have been studied as, a crystallizing operation. This unfortunate approach has contributed much to the present problem of caking in bulk handled granulated sugars.

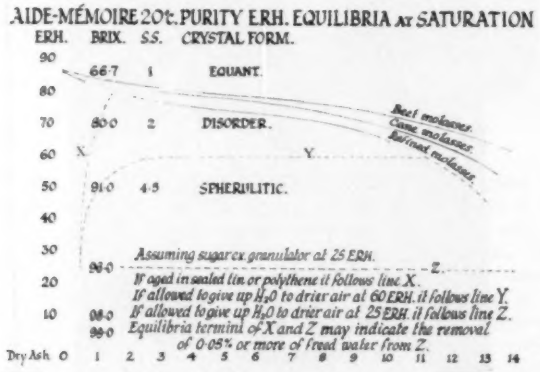


Fig. 1.

In pan boiling, the panman carefully controls the degree of supersaturation of the mother syrup to the optimum for good crystal development. In the granulator the thin film of syrup on the surface of the crystals is exposed to such fierce drying conditions that the very rapid evaporation produces supersaturations rising to 2, 3, 10, or more. At these higher levels the rate of crystallization, far from being speeded up, is progressively retarded, and the crystal surfaces become covered with something approaching an amorphous "glass."

PALMER and co-workers[1] have shown that this amorphous form, as produced by spray drying, exhibits a very low vapour pressure and, according to the degree of dehydration, may take days, weeks, or even months to crystallize.

In the granulator the abrasion of each crystal with its neighbours produces a great deal of nucleation within the film whilst drying, so that the resulting crystal may end up covered with anything from a hard, almost non-crystallizing glaze, to a micro-grained fondant set in a similar glaze, according to the actual conditions of granulation.

Vapour pressure measurements are most illuminating when interpreted in the light of my diagram (which is put forward rather as an aide-memoire). To interpret the diagram, the left hand columns relate to pure sugar solutions only, whereas the effects of the presence of non-sugars is indicated in the superimposed curves.

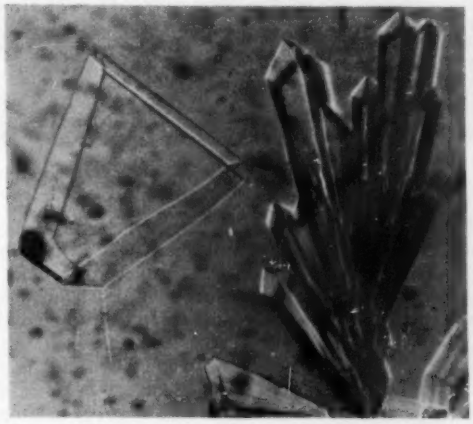


Fig. 2

Thus a granulated sugar, when dried far too rapidly to permit crystallization to keep pace with concentration, may achieve an E.R.H.[2] of 25 or much lower. The surface layer will then be at a supersaturation far above 10, yet it may include an appre-

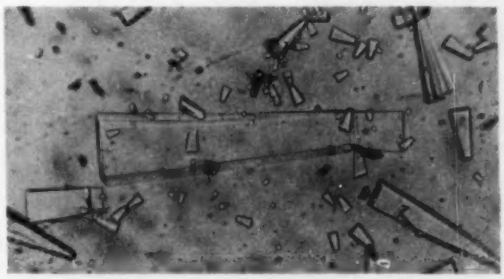


Fig. 3

ciable amount of water of solution. Crystallization will take place extremely slowly, the surface layer will exhibit a rising E.R.H., and an increasing amount of the solution water will be able to send water

[1] *J. Agric. Food Chem.*, 1956, **4**, (1), 72–77, 77–81.
[2] POWERS: *I.S.J.*, 1951, **53**, 254–255.

molecules into the surrounding air space, i.e. to become a potential source of caking due to moisture migration. This reaction would proceed more rapidly at higher E.R.H. levels, thus producing the unexpected phenomenon that sugar submitted to too vicious drying conditions may take longer to equilibrate than that dried under milder conditions.

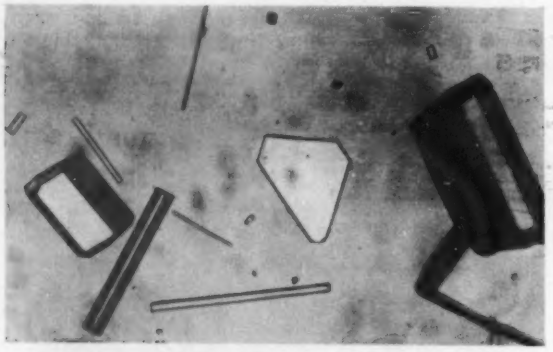


Fig. 4

The quantity of water concerned is small—of the order of 0·02 to 0·06%, and when hessian or paper packing material is present this moisture is held by these convenient buffer absorbents, but with bulk handling it is able to build up to troublesome proportions locally. It is pertinent to point out that a hypothetical 0·03% moisture, even at 50 E.R.H., is associated with some 90% of dissolved solids in the surface syrup, not 67% as in the case of ordinary saturated pure sucrose solution at 86 E.R.H. This corresponds to about 0·3% of syrup, not 0·1%. It is pertinent also to point out how the subject of internal water is developing. It may be truly and more or less permanently held internally in inclusions[3],

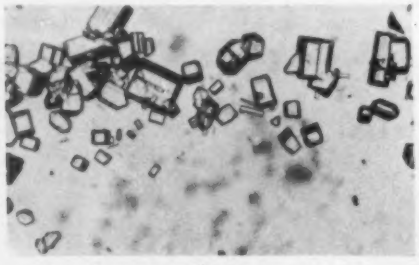


Fig. 5

or it may be held less irrevocably between the fondant-like crystallites in the dried surface film or in the glass-like fluid, being slowly released from these two positions. Finally, it may be present in a surface film of low purity syrup at near equilibrium with the superincumbent atmosphere.

It will be seen that there is a strong case for devoting more study to sucrose crystallization at these very high supersaturation levels. By operating with thin films of syrup exposed to atmosphere of controlled humidity, "molecular evaporation" may be carried to any degree of supersaturation ("SS") without causing mechanical nucleation. The sugar molecules in these films are extraordinarily slow in bringing about nucleation, even though so supersaturated. When nucleation does occur the nuclei produced at about 1·5 to 2·0 SS show some signs of internal disorder, often having "supporting columns" on either side of a wedge-shaped body.

At 2·0 to 3·0 SS an increasing proportion of multi-crystals appear, of a type known to crystallographers

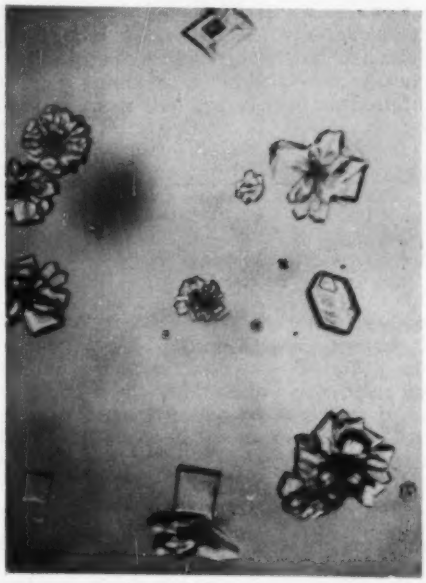


Fig. 6

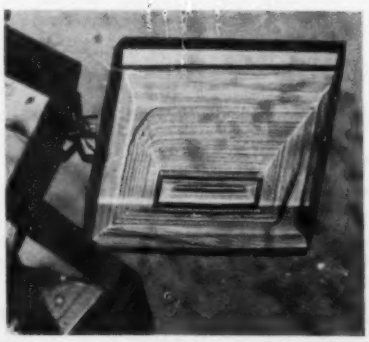
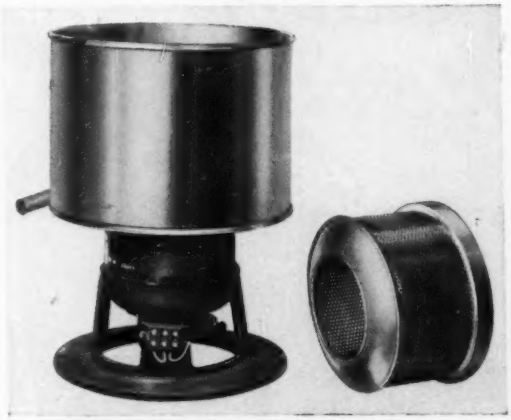


Fig. 7. A "hopper" crystal, grown on an exposed pure syrup surface which has recorded unquestionable evidence of the change from acicular to near equant type during growth.

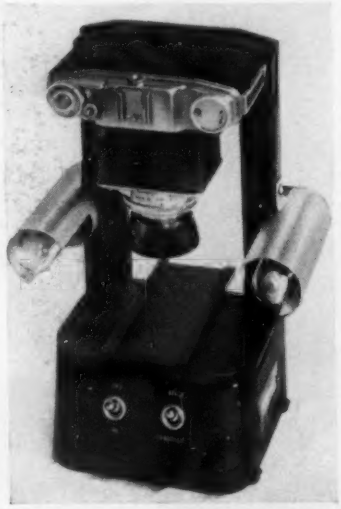
[3] POWERS: *I.S.J.*, 1959, **61**, 17–18, 41–44, also *Nature*, 1958, **182**, 715–717.

MASSECUITE EXAMINATION



The surest way of determining the recoverable crystal content of a massecuite is to spin a sample in our **LABORATORY CENTRIFUGAL.** This robust electrically driven machine operates at speeds variable from 1000 to 2000 r.p.m. and is provided with either a 6 in. diameter basket 4 in. deep or an 8 in. basket 6 in. deep, both having $\frac{1}{8}$ in. perforations. Construction is in Monel metal and the unit is complete with electric motor and regulator. A.C. single-phase voltage and frequency must be stated when ordering.

Our **SATUROSCOPE** is designed for easy visual determination of the saturation temperature of a massecuite. The sample cell and thermometer pocket (containing mercury for good heat transfer) are in close proximity in the heated block which is of solid copper. This arrangement allows measurement of the temperature in the sample cell to an accuracy of $\pm 0.5°C$. Using a polarized light source, the massecuite is examined through the $\times 65$ microscope which allows the saturation point to be observed clearly. The heating element uses 110/260 volt single-phase A.C. and is provided with a fine control for the rate of heating.



A permanent record of each strike —either as massecuite or sugar— can be made easily and quickly by means of our **CRYSTAL CAMERA.** Samples lit by side or polarized sub-stage illumination are photographed using a specially modified 35-mm. Agfa camera, yielding a negative which records the crystals at exactly their original size and which may be enlarged or projected for study. A single cassette of film will provide a record of 36 strikes, so that use of the camera is cheap and suitable as a routine measure in both sugar factories and refineries.

Write now for further details of our complete range of equipment.

The Sugar Manufacturers' Supply Co. Ltd.

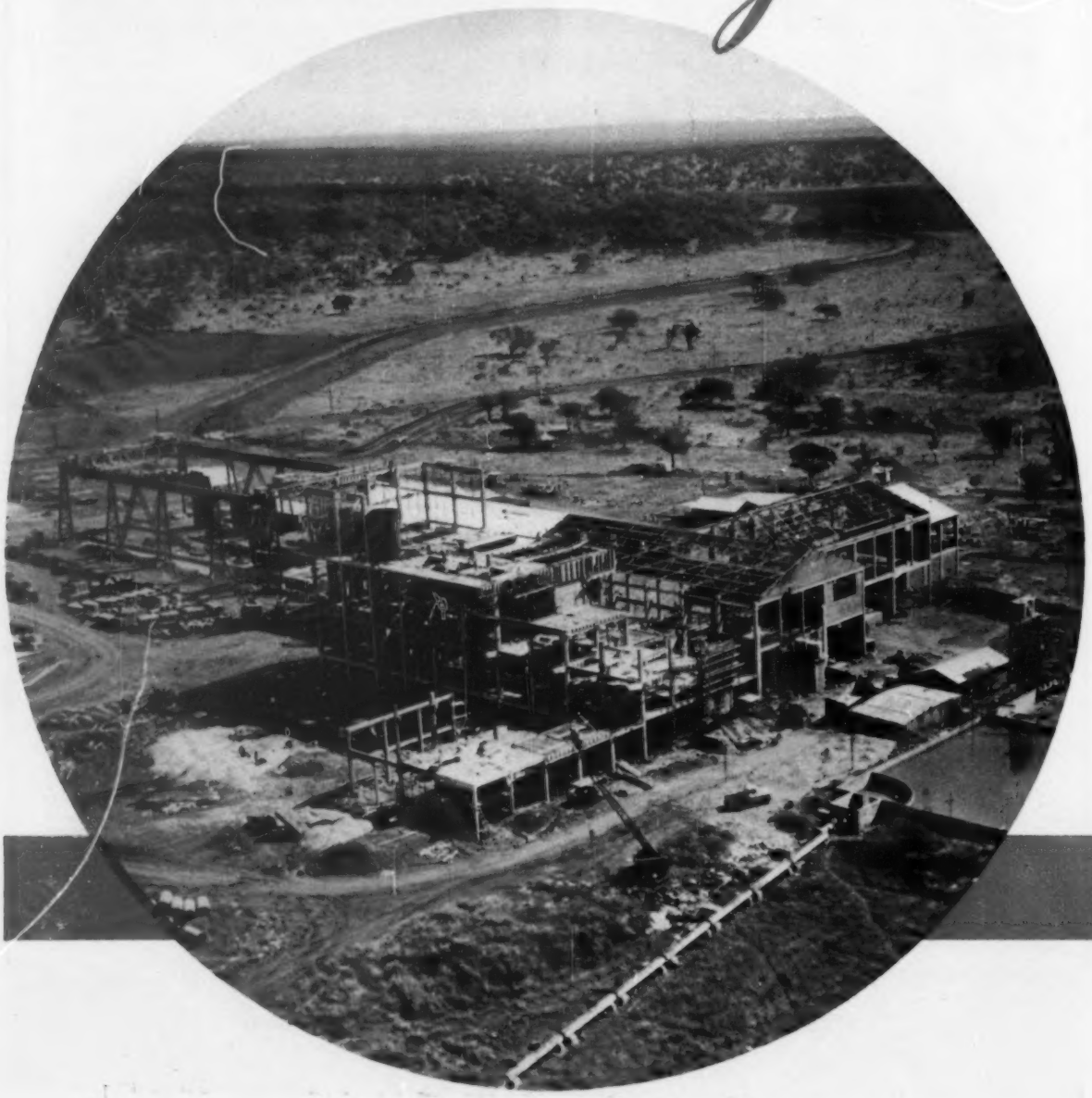
7 & 8, IDOL LANE, LONDON, E.C.3, ENGLAND.

Cables: "Sumasuco, London."

SMITH

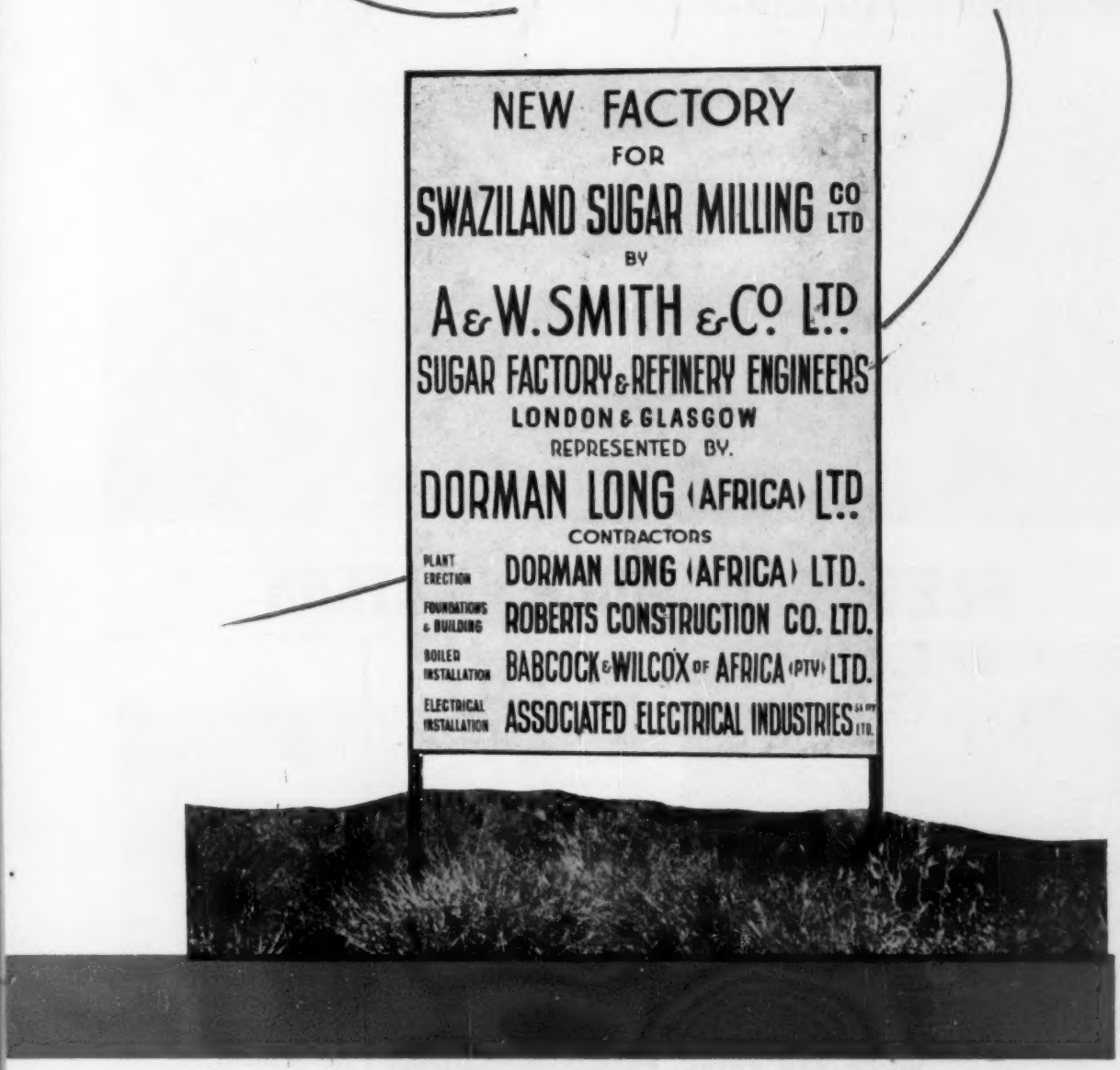
SUGAR

Machinery

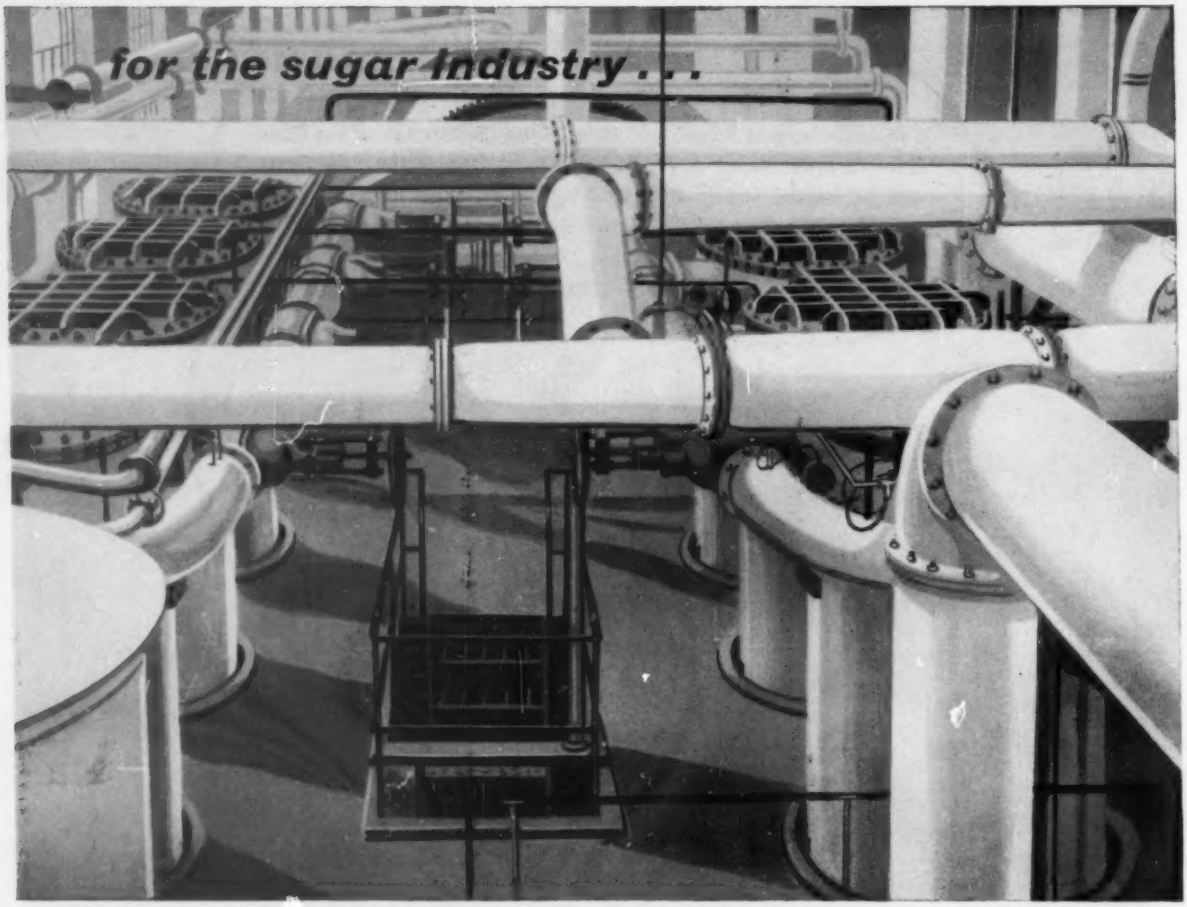


PROCESS:

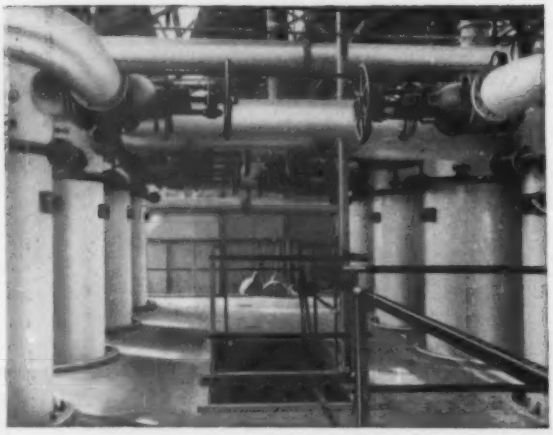
Simple Defecation System will be used for Clarification of the Cane Juice in manufacture of Raw Sugar. A portion of the Raw Sugar will be melted and treated by Single Continuous Carbonatation and Filtration followed by slight Sulphuring and Second Filtration prior to Boiling for White Sugar. CO_2 for Carbonatation will be drawn from the Boiler Flue Gases.



INITIAL GRINDING RATE: 75 Tons of Cane per Hour.
FUTURE GRINDING RATE: 120 Tons of Cane per Hour.
OUTPUT: 25% Raw Sugar, 75% Refined White Sugar.



FLETCHER JUICE HEATERS



In these illustrations we show nine mild steel JUICE HEATERS which have been supplied to the British Sugar Corporation's factory at Ely. Each heater has a heating surface of 220 sq. metres and will work in conjunction with the largest R.T. Diffuser so far manufactured, which has a diameter of 6.75 metres. For some years now the Fletcher organisation has been supplying top quality machinery to both the beet and the cane industry at home and abroad.

WHEN YOU THINK OF SUGAR MACHINERY THINK OF

FLETCHER

complete plant for the sugar industry

CANE KNIFE SETS—
MAXWELL SHREDDERS—
FLETCHER MILLS—
"ATLAS METAL"
MILL ROLLERS—
MAXWELL-
BOULOGNE LIQUID SCALES—
JUICE HEATERS—
FORTIER CLARIFIERS—
FILTER PRESSES—
SEALED DOWNTAKE
EVAPORATORS—
CENTRE FLOW PANS—
DRY AIR AND CO,
GAS PUMPS—
FLETCHER CRYSTALLISERS—
AMARILLA ROTARY
DISPLACEMENT PUMPS
FOR MASSECUITE
& VISCOUS LIQUIDS

GEORGE FLETCHER & CO. LTD., MASSON WORKS, LITCHURCH LANE, DERBY, ENGLAND. TEL: DERBY 45817

GRAMS: "AMARILLA" DERBY

P.3336 AH

as spherulites. By 4·0 SS all nuclei appear to be spherulitic. As produced in thin films, I have called the almost two-dimensional form a radialite, and the illustrations will show that the component crystals all appear to radiate from a common origin. Each ray is a single crystal and the usual interfacial angles may be recognised. It is highly probable that some of our commercial agglomerated grain, produced by nucleating the pan at too high a supersaturation, is of spherulitic form.

Under suitable conditions these growths are dendritic and rhythmic, the pattern being repeated again and again as with reflections in parallel mirrors. (The term "dendritic" means "branching like a tree".)

The introduction of various non-sugars, and the operation at high temperatures, etc. are producing a wonderful panorama of crystal growth forms, and, without doubt, the study will facilitate our understanding of the strange by-ways of crystal growth.

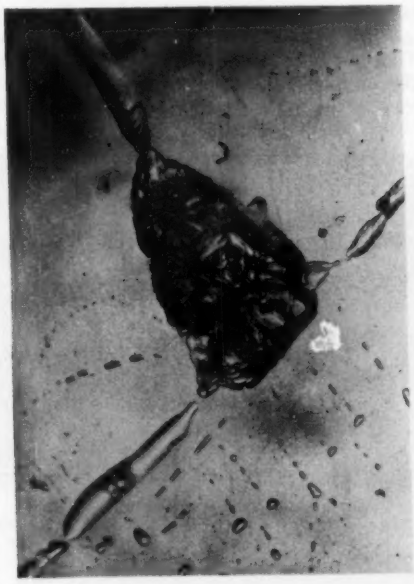


Fig. 8. A glass/syrup/air system where a film of pure sugar solution, spread on a glass surface, has coalesced into a characteristic drainage system which has then been exposed to air at about 50 R.H. Multi-spherulitic nuclei have formed in the largest droplet and one or two in other smaller droplets. Exploring growth is developing along one connected unnucleated arm of the largest droplet.

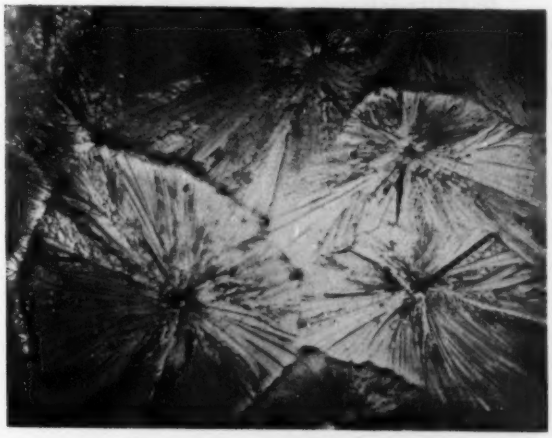


Fig. 10. Well-spaced spherulitic nucleation has occurred in a thin film of pure slightly subsaturated syrup carefully prepared and exposed to an atmosphere of low R.H. in a glass/syrup/air system. The resulting growth has made a good radialitic carpet.

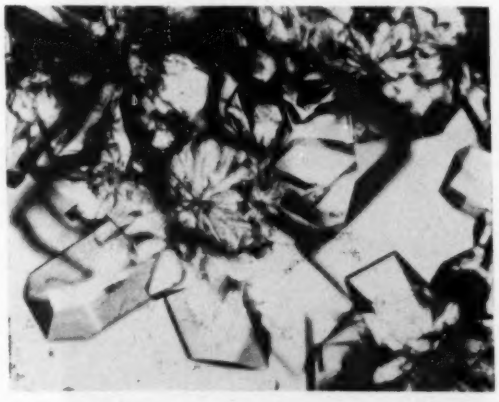


Fig. 9. In a fairly thin layer of pure syrup exposed to a drying atmosphere, euhydral nucleation and growth has become well established before the syrup has attained the degree of supersaturation which leads to sperulitic nucleation; this has been established in due course, however.

Fig. 11. A euhydral crystal which has developed a later spherulitic growth; this is a frequent phenomenon.

At no time is the surface of a sugar crystal ever truly static, but rather in a state of slow dynamic change, striving gradually to achieve the most stable form under the conditions of storage at the moment.

Experimental thin film crystallization may be classified under three headings, according to the nature of the bounding media:

(A) Glass or plastic (relatively inert)—thus, glass/syrup/glass.

Fig. 12. A striking radialite crystal.

(B) Atmosphere with controlled humidity (this facilitating migration of water molecules to or from the film)—thus, glass/syrup/atmosphere.

Fig. 13. The junction of neighbouring radialites in a film, with notable replication chain of rhythmic growth also blanket-like folds.

(C) Sucrose cleavage faces (offering or receiving sucrose molecules to or from the film)—thus, sucrose crystal/syrup/atmosphere.

We will consider these in the above order.

(A) *Glass/syrup/glass*

The simplest bounding media are the usual 3 × 1 inch microscope slide and a cover slip. For more elaborate work it is relatively easy to make temperature controlled flow cells in modern transparent plastic sheet. The basic operational technique is relatively simple, particularly for those with some experience of micro-biological operations.

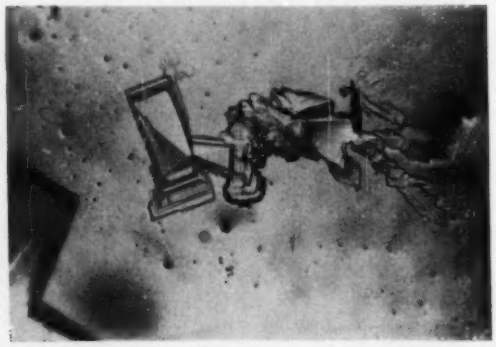


Fig. 14. An isolated crystal developing dendritic exploring growth.

Fig. 15. A striking periodicity pattern of rectilineal contour developed by rhythmic dendritic growth in a fairly continuous drainage film.

A solution of pure sucrose in water is prepared, slightly supersaturated at 20°C. It is warmed to attain slight subsaturation and placed on a warm slide. A needle is dipped into icing or fondant or some other source of nuclei, and a line "drawn" along the slide. The syrup is covered with a cover slip and watched under the microscope as the seed grains grow. It is soon evident that they grow at very different speeds, even though growing in the same medium[4]. This offers one of our major research challenges. When conversant with the operation one may vary the degree of supersaturation, and also introduce a wide variety of non-sucrose constituents,

Fig. 16. Another periodicity pattern of leaf-like form.

in order to study the resulting effects on form and growth rate.

As an example of the effect of introducing non-sucrose impurity, I have found that the addition of increasing amounts of raffinose leads to a corresponding increase in the axis ratio of the sucrose crystals at the lower concentration but at 10% upwards striking wedge-shaped crystals are formed and clusters of apparent needle shaped crystals abound (Figs. 2, 3). Impurities are certainly not the the only cause of shape variation, for I have been able to grow striking variations in form even in pure sucrose solution (Figs. 4, 5).

Development of this technique of inoculation with various types of nuclei opens the way to a great deal of interesting study regarding "inheritance." By drawing two lines at right-angles, using two needles each dipped in a different nucleating medium, one may carry out comparative tests of their relative merit, when grown in the same medium. For example. my impression is that crushed grain such as icing sugar repairs itself at a considerably accelerated rate as compared with well-formed grain such as a fondant, but that once the icing sugar has formed perfect grain this rate differential is lost. This is in agreement with the recent studies of R. M. McCready and his team[5]. Again, from such an approach I have formed the opinion that a crystal which has developed in some characteristic form by virtue of the medium in which it has grown, when transferred to a different medium, still "tries" to continue growing on the old pattern, but loses efficiency. New nuclei of the form characteristic of the new medium grow more vigorously and soon predominate.

(B) *Glass/syrup/atmosphere.*

This second system is even more exciting, once one has mastered the basic principles. A thin film of syrup will be able freely to interchange water molecules with the surrounding atmosphere, and thus may be maintained at a desired supersaturation even as some of the sucrose crystallizes. Moreover, the initial formation of nuclei only takes place when

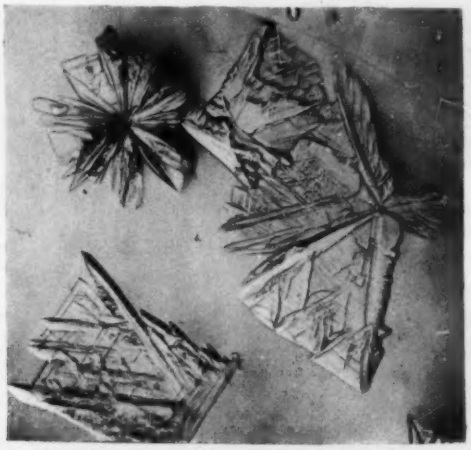


Fig. 17. Radialitic crystals grown at 3·3 supersaturation from a sucrose solution containing 10% dextrose.

a suitable number of sugar molecules have by chance come together; hence, the first appearance of nuclei will be approximately proportional to the amount of syrup and will be most tardy in a thin film or detached droplet. Thus we can operate with thin films of astonishingly high supersaturations without embarrassing nucleations. One may control the vapour pressure of the atmosphere by various means, for example, by using moistened salts, or sulphuric acid, or glycerine of the appropriate concentration. I have, by this means, examined films of pure sucrose solution from 1 to well over 10 of supersaturation(SS).

[4] Bjerager: *Report of the Central Laboratory, A/S De danske Sukkerfabrikker*; also Powers: *Proc. 10th Congr. I.S.S.C.T.*, 1959, 242.

[5] Private communication, to be presented to the Amer. Soc. Sugar Beet Tech., 1960.

Nucleation and growth rate appear to be maximal at about 3 SS, but even in this region only a dozen or so nuclei may appear on a slide within the first day or two. At 1·5 SS weeks may pass, whilst at the 10 SS level, nucleation seems to be conspicuous by its absence!

At the 4 SS level, nuclei appear of a multi-crystal spherulitic type, as mentioned above. One does not readily think of such extremely high supersaturations being attained by the syrup in a vacuum pan, but this may be the case in the bubbles formed by surface evaporation. In Fig. 6 it is seen that spherulitic agglomerations may be found in the meniscus of a syrup exposed to normal atmosphere in a room. C. MOLLER[6]

Fig. 18. Radialitic crystals grown at 3·3 supersaturation from a sucrose solution containing 10% levulose.

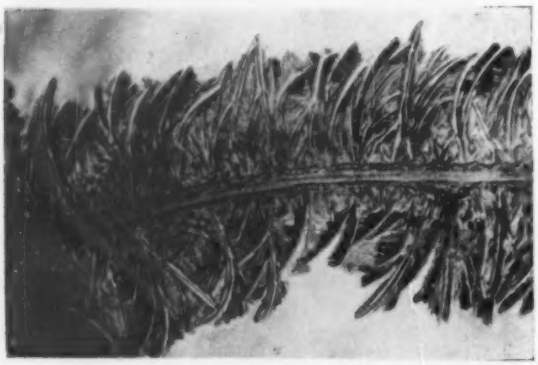


Fig. 19. Radialitic crystals grown at 9·0 supersaturation after nucleation on a scratched tine.

reports noting two different types of agglomerates in sugar, a starlike type which in the accompanying illustration appears spherulitic, and a simple cluster of two or three individual crystals[7].

So far, I have been dealing with crystals which, though growing in a thin film, were still fully immersed in syrup. I would now like to describe crystal growth of incredible beauty which develops when the film is too thin to cover the crystal. In a Petri dish is poured sufficient pure slightly sub-saturated liquor to cover the bottom to the depth of a millimetre. After adding several crystals the glass cover is fitted and the system allowed to stand for several weeks at room temperature. Water molecules migrate very slowly from the syrup out of the dish. The crystals commence growing and liquor is drawn to and up the crystal surfaces by dynamic forces, evaporates and deposits its sucrose molecules. Ultimately the dynamic forces are unable to draw any more syrup from the very thin remaining layer. Now the crystals really "show initiative," and develop the truly remarkable growth I have called "exploring growth," this leading to the production of periodicity patterns. Some of the illustrations give some idea of the infinite variety of form and the rhythmic growth which is a "crystallization equivalent" of the Liesegang precipation phenomena. Not the least surprising feature of this growth is that the whole of each fantastic section is a true single crystal of sucrose, with the component molecules all in sympathetic orientation with one another. These exploring growths are truly dendritic, since the angles may be seen to be those which characterise the sucrose crystal.

(C) *Sucrose/syrup/atmosphere.*

The amorphous glaze referred to above, which crystallizes extremely slowly is an example of the third type of thin film crystallization. The overdried syrup on the surface of the crystal will survive exposure to a drying atmosphere for many hours and even days. This is one of the major causes of the phenomenon known as ageing or maturing of sugar, the other being the continual slow changes going on at the surface of the crystal, whereby the smallest crystals dissolve and the larger receive the additional molecules, thus liberating the water in the film.

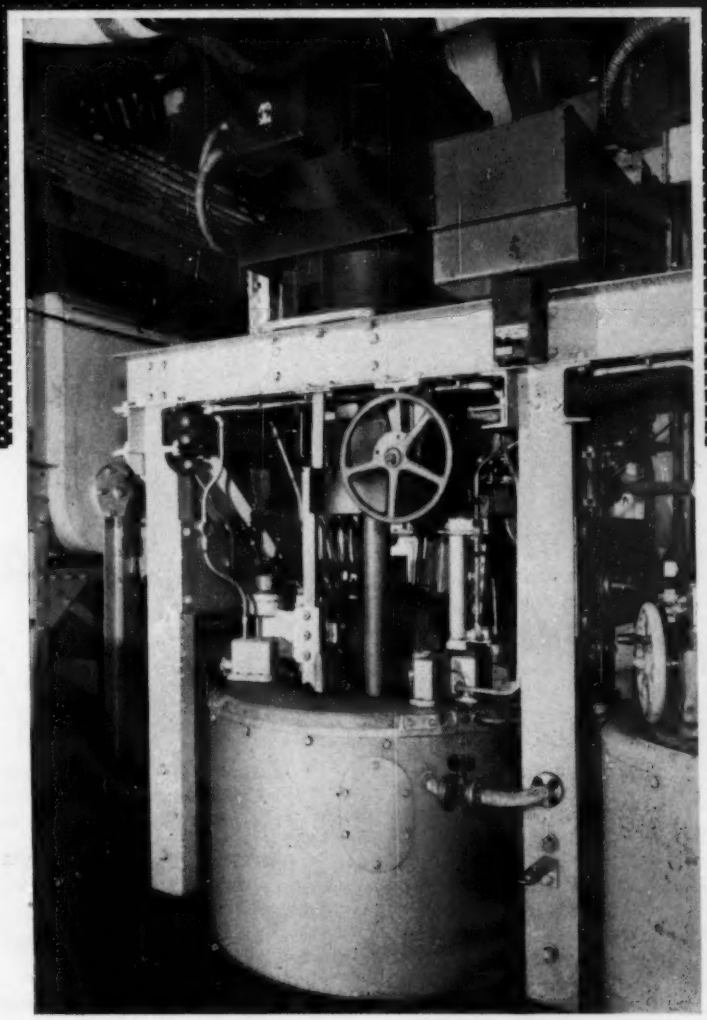
(EDITOR'S NOTE.—The selection of illustrations reproduced gives some indication of the beauty and complexity of this sucrose crystal growth, as revealed in Mr. POWERS' slides.)

Factory capacity increase in the U.S.[8]—An interesting project is now being undertaken at the Holly Sugar Corporation factory in Carlton, California, where beets planted in the Autumn are harvested from May until mid-July when the temperature, rising to 52°C, would shrivel them. The Company has cultivated double the usual amount of beet, and the capacity of the factory is to be increased from 3900 tons to 7800 tons. The capacity of the sugar end is not being increased, however, and excess thick juice, stored in tanks in the open air, is to be processed after the beet campaign. The idea has been discussed for some years but the Holly Sugar Corporation is believed to be the first to carry it out. Many factories do almost the same thing, producing liquid sugar which goes directly onto the market, and is not subsequently boiled to crystal sugar.

[6] *Sugar*, 1954, **49**, (11), 49–50.
[7] See also POWERS: *Nature*, 1960, **188**, 289.
[8] *Zeitsch. Zuckerind.*, 1960, **85**, 365.

FULLY AUTOMATIC CENTRIFUGALS

P&W



Our latest design of Fully automatic Centrifugal gives complete automation in centrifuging. There are no labour training problems; no allowance is necessary for human error. Each phase of the cycle can be preregulated for the type of sugar being cured.

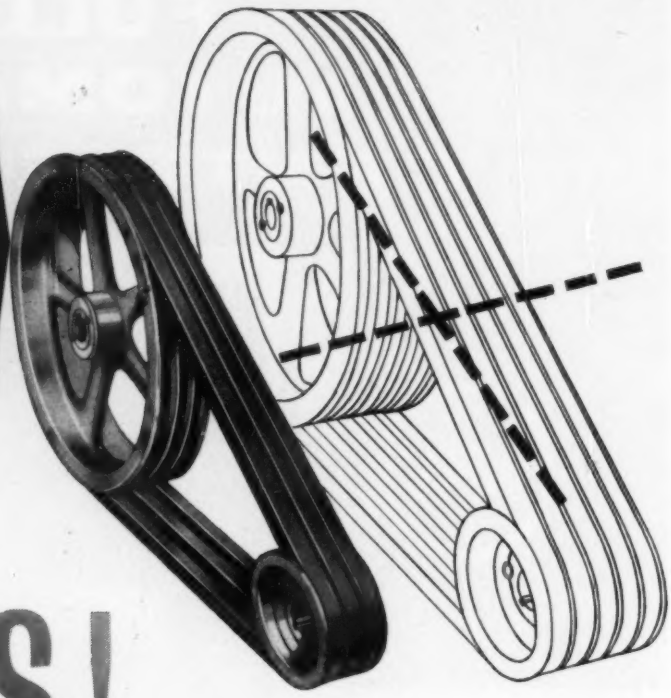
POTT, CASSELS & WILLIAMSON LTD.

A Member of The Mirrlees Watson Group

Motherwell Lanarkshire Scotland

Cables: Pott, Motherwell

CROFTS ULTIVEE ROPE DRIVES!



minimum space—maximum power capacity

CROFTS ULTIVEE ROPE DRIVES HAVE ALL THESE FEATURES AND ADVANTAGES . . .

- Compared with orthodox V-Rope Drives, Crofts Ultivee Rope-Drives transmit more power in less space, reducing the number of ropes as much as 40 per cent.
- Permit smaller pulley diameters and face widths with shorter centre distances—the weight of the whole drive is thus reduced.
- A standardised range of pulleys is available either taper bored for Crofts Patent Taper-Flushbushes or Parallel bored with keyway.
- Only three sections of ropes in a large range of lengths are used, the two smaller sections covering the majority of industrial requirements.
- Installation and replacement costs materially reduced.

Write today for further details.

Ultivee Drives are offered as an addition to our range of V-pulleys and "Supror" Ropes—the existing range of "Supror" V-Ropes and/or pulleys is still available as required.

Crofts
REGD. TRADE MARK

CROFTS (ENGINEERS) LTD.

POWER TRANSMISSION ENGINEERS
THORNBURY BRADFORD 3 YORKSHIRE

Telephone: 65251 (20 *lines*)
Telegrams: "*Crofters Bradford Telex*" *Telex* 51186

WORLD-WIDE REPRESENTATION

AN ABNORMAL CONSTITUENT OF THE ASH CONTENT OF BEET SUGAR FACTORY PRODUCTS

Experiences in some B.S.C. factories in recent campaigns

By WILLIAM H. PARKER, M.B.E., M.Sc.
Chief Chemist, British Sugar Corporation Ltd.

PART I

IN the process control of every sugar factory one of the most important routine control tests is that of the ash content of the juices. The non-sugars are normally carefully controlled because of their melassigenic properties and, in particular, the mineral matter, notably the salts of the alkalis and alkaline earths. The latter, generally referred to as "lime salts", are kept at a minimum, also in order to avoid scale formation in evaporators, heat exchangers, etc., and to eliminate any possibility of turbidity in the final product where this is white sugar.

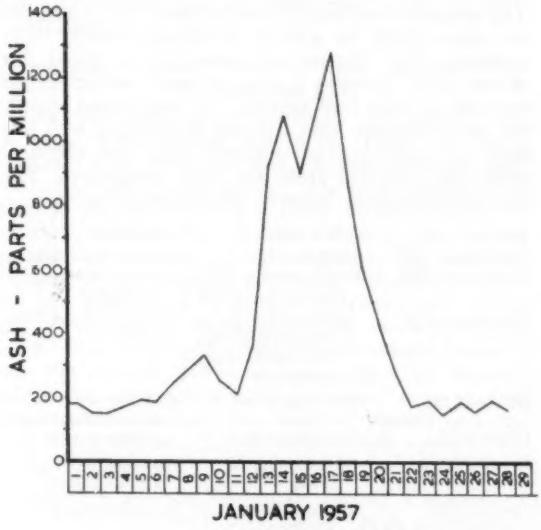


Fig. 1

It is very disturbing, therefore, when the ash content of process liquors suddenly rises for no apparant reason. In fact, as has happened on occasion in the past in our factories, the increase is carried right through to the sugar end, causing an abnormally high ash in the massecuites and in the granulated sugar, by as much as ten times the normal figure. Such occurrences generally take place towards the end of a campaign when beets have deteriorated in quality to varying degrees, and the classic example in our experience was at Allscott factory in the final weeks of the 1956/57 campaign. At first the rise was gradual, starting on the 6th/7th January, 1957 mostly during the night shifts. By the 12th it was well established and during the succeeding days the daily average white sugar ash content jumped, reaching a peak on the tenth day. During the following week the ash content fell gradually to its normal level and remained so for the rest of the campaign, except for the last three white pans boiled, in which the ash contents were again very much higher than the accepted maximum figure of 0·02%. The overall picture is given graphically in Fig. 1.

The position was really alarming. An investigation was started at once by our Works Chemist at Allscott, Mr. A. E. CRAGG, and followed up by our Central and Research Laboratories. The results were very conclusive and enabled remedial measures to be applied so successfully in the process that it is thought that a detailed account of our findings will be of considerable interest and probably also of great benefit to others in the beet sugar industry who may encounter or may have already had similar experiences. These was a recurrence at Allscott during the whole of the following campaign, but to a much lesser extent, and at Cantley and Kidderminster factories. It also occurred at Felsted during 1958/59, but, again, not to any serious extent. In 1959/60 no factory had any such difficulty. The conditions appear to arise mostly when working deteriorated beets when the nitrate content of juices rises, and when there is also more oxidation of SO_2 to SO_3 in the process. The offending substance appeared to be co-crystallized with the sugar from which it was impossible to remove it by washing. It persisted whether the grain size of the sugar was small or large.

A salt was eventually isolated from the sugar and identified as potassium imido-disulphonate (IDS) and when later the same compound was found settled out in considerable quantities from molasses corresponding to a period of high white sugar ash, the identity of the contaminant was finally confirmed.

ISOLATION AND IDENTIFICATION OF THE COMPOUND

Microscopic study

A crystal of high ash sugar is clearly distinguished from that of normal sugar because it sheds its ash crystals when placed in a drop of water. This is seen clearly under low-power magnification. In water the ash crystals drift away continuously as the parent sugar crystal dissolves, but soon lose

their shapes and eventually themselves dissolve. The most striking effect is obtained by using a nearly saturated KCl solution instead of water; this prevents the ash crystals from dissolving but not the sugar. When the sugar crystal has finally vanished the site is left littered with up to about 50 small crystals of ash (see Fig. 2 below). Strong basic lead acetate solution (BLA) has the same effect, while ammoniacal $BaCl_2$ solution produces a sharply defined envelope round each ash crystal.

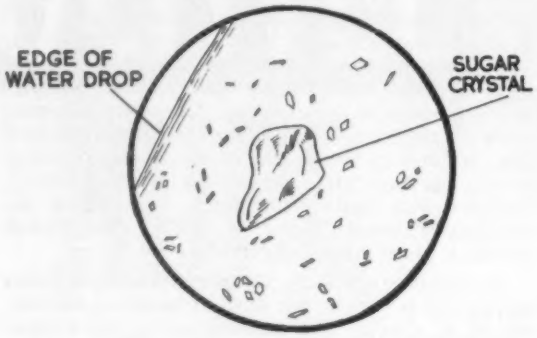


Fig. 2

Chemical behaviour

The behaviour of the substance in sugar solution was examined; it had high conductance, agreeing roughly with gravimetric estimation and was therefore fairly well ionized. When treated with barium chloride reagent it gave no precipitate at first but barium sulphate was deposited very slowly on boiling. A white precipitate also appeared on boiling with $BaCl_2$ and HCl. Barium hydroxide, $BaCl_2$ + ammonia, and basic lead acetate all gave flocculent white precipitates. No other reagents were found to give precipitates and no curdling occurred when the solution was digested with fresh milk for an hour at 100°F.

Behaviour of this sort with $BaCl_2$ + HCl is observed with the alkyl sulphuric salts of the $KRSO_4$ where *R* is an alkyl or more complex group. The simplest is potassium methyl sulphate, while many higher esters are known, even including those derived from sucrose. The potassium salts are well ionized but no reference has been found in the literature to insoluble basic salts of barium or lead.

Another class of compounds, the polythionates (salts of the thionic acids $H_2S_nO_6$, where $n = 2, 3, 4, 5$ or 6), give sulphuric acid on boiling with HCl. Dithionic acid, for example, behaves as follows:

$$H_2S_2O_6 = H_2SO_4 + SO_2$$

while the higher thionic acids also precipitate sulphur. The ash constituent, however, did not seem to respond to tests for thionates.

Isolation of the acid

The basic lead salt was precipated from the solution of high-ash sugar and the precipitate, after washing, was treated with hydrogen sulphide. The lead sulphide was filtered off and the filtrate exaporated to dryness, yielding needle-shaped crystals which were probably the acid corresponding to the original compound. This was deliquescent, strongly acid and some charring occurred as the residue approached dryness. It appeared that some hydrolysis occurred during the evaporation, producing a certain amount of sulphuric acid. By cautious washing of the residue it was possible to obtain a little of the crystals free of sulphuric acid.

By neutralization of the acid with sodium hydroxide it was possible to obtain a crystalline sodium salt. When this was ignited with sulphuric acid there was considerable charring, but this was found to be due to contamination by sugar. Later, an acid of identical appearance was obtained from the barium compound (see below).

Preparation and examination of a crystalline barium compound

The sugar solution was treated with $Ba(OH)_2$ or $BaCl_2$ + ammonia, and the flocculent precipitate filtered off, washed and dissolved in acetic acid. The solution was filtered and treated with ammonia or other alkali to give a precipitate which, after washing, was allowed to granulate in water for several days, forming a crop of short needle-shaped crystals of pale buff colour. As mentioned above, the acid obtained from this salt by treating with less than its equivalent of sulphuric acid was identical with that obtained from the lead compound. The barium compound behaved as indicated below.

Reagent	*Observation*	*Inference*
Cold dilute HCl Hot dilute HCl	Soluble $BaSO_4$ precipitated slowly on boiling	Similar behaviour to the original substance
Hot dilute H_2SO_4	$BaSO_4$ precipitated. No smell of SO_2 or volatile organic substances	Absence of sulphite
Dilute H_2SO_4 + $KMnO_4$	No colour loss	Absence of unsaturated carbon-carbon bonds
Dilute H_2SO_4 + Br_2	No colour loss	
Concentrated H_2SO_4	No charring or smell	Absence of carbohydrate
Concentrated H_2SO_4 + $K_2Cr_2O_7$	Green colour produced	Reducing agent
Boiling KOH	No ammonia or other effect	Absence of NH_4 radical
Ignition alone	Sublimate, identified as ammonium sulphite	Presence of sulphonic and amino groups
Ignition with soda lime	Ammonia liberated	Presence of amino group
Ignition with sodium acetate	Smell of charring and faint smell of H_2S, no ester smell	Not a simple alkyl sulphuric salt

The residue from ignition of the barium compound appeared to be solely barium sulphate, the ammonium sulphite distilling off without altering the crystal shape, although the colour became grey and then

white. A faint yellow film on the glass tube below the sublimate deposit was similar to that produced by the reaction of dry SO_2 on dry NH_3. The amount of sublimate was quite a small proportion of the original compound.

[It was later found that the basic barium compound may be precipitated with excess $Ba(OH)_2$ or $BaCl_2$ + ammonia, the most compact precipitate being obtained, as with lead (see below), by adding the sugar to the hot barium solution. The conversion of this compound to the acid by addition of sulphuric acid was found to be unsatisfactory.]

Preparation of the basic lead salt

About 50 ml of concentrated BLA were added to 600 ml of distilled water which had been boiled previously to remove dissolved CO_2. About 500 g of sugar was stirred in until dissolved. The bulky flocculent precipitate soon settled and gathered into a heavy compact sediment from which the sugar solution was decanted. Washing of the precipitate was very simply achieved by alternately shaking with distilled water, settling and decanting. If the BLA is added to the sugar solution the precipitate is very slow to consolidate and, when it does so, takes in a considerable amount of sugar, probably as lead saccharate.

Preparation, chemical behaviour and composition of the potassium salt

The combined lead precipitates from about 2 kg of sugar were washed into a flask and the slurry shaken in the presence of hydrogen sulphide until absorption of the gas ceased. The lead sulphide was filtered off and the filtrate made faintly alkaline to phenolphthalein with potassium hydroxide. (The solution blackens on approaching neutrality, probably because of the presence of ferrous sulphide, so that the end-point must be judged externally on a white tile.) The slightly alkaline solution was evaporated on a steam bath until crystallization started, when it was left to cool and stand overnight. The crystals, which are sparingly soluble in water, were washed with water, dissolved, the solution filtered and the salt re-crystallized.

On heating the dry salt alone a sublimate of ammonium sulphite appeared, leaving a residue of potassium sulphate; on heating with soda lime ammonia was evolved. The salt in solution was apparently stable to boiling with KOH since no ammonia was evolved. On boiling with HCl and treatment with $BaCl_2$, $BaSO_4$ was precipitated. This chemical behaviour again suggests the presence of a sulphonate group and an amino group as well as potassium. These three were determined, respectively, by digestion with nitrous acid* and precipitation of $BaSO_4$ with $BaCl_2$, normal Kjeldahl estimation of nitrogen, and determination as K_2SO_4 by ignition with sulphuric acid. The results of the analyses corresponded to the formula $NH(SO_3K)_2$ of potassium imido-disulphonate. Thus the free acid would be imido-disulphonic acid, and the presence of sulphuric acid in the isolated free acid may be attributed to hydrolysis to sulphamic acid during the evaporation: $NH(SO_3H)_2 + H_2O = NH_2SO_3H + H_2SO_4$. The potassium salt crystals obtained in this manner, when placed in a drop of saturated potassium chloride solution and examined under the microscope appeared very similar to those obtained directly from the sugar crystal.

* NOTE—It appears that the simple treatment with boiling HCl does not convert the whole of the sulphonate to sulphate and, therefore, the full value is not obtained. Failure to realise this in the early stages considerably hindered the progress of the investigation.

THE AMMON-SULPHONIC ACIDS

Imidio-disulphonic acid is one of the three ammon-sulphonic acids. These are mainly known in the form of their potassium salts but little appears to have been published on their chemistry. Among early workers on the acids were CLAUS, DIVERS, FREMY and RASCHIG. The acids are formed by the replacement of the hydrogen atoms of ammonia with sulphonic groups and solutions of the tri-sulphonate potassium salt are broken down by boiling with water to yield first the disulphonate and then the monosulphonate:

Potassium nitrilo-trisulphonate (ammon-trisulphonate) $N(SO_3K)_3$ $\downarrow H_2O$

Potassium imido-disulphonate (ammon-disulphonate) $NH(SO_3K)_2 + KHSO_4$ $\perp H_2O$

Potassium sulphamate (ammon-monosulphonate) $NH_2SO_3K + KHSO_4$

The production of an acid salt at each stage of the hydrolysis is of possible significance in connexion with sucrose inversion.

The trisulphonate may be obtained by mixing solutions of potassium sulphite with potassium nitrate, but a better yield is obtained by bubbling SO_2 into a solution containing KOH and KNO_2.

$$2KOH + 3SO_2 + KNO_2 = N(SO_3K)_2 + H_2O$$

The disulphonate may be obtained by hydrolysis of the trisulphonate, as mentioned above, or in the form of two ammonium salts by the action of sulphur trioxide on ammonia, viz. $NH[SO_3(NH_4)]_2$ and $N(NH_4)[SO_3(NH_4)]_2$. As a point of academic interest, this is a unique example of a hydrogen atom in an amino group acting as an acid H and being replaced by an ammonium radical.

The monosulphonic acid, besides being produced by hydrolysis of the disulphonic acid, also results from the action of fuming sulphuric acid (oleum) on urea: $CO(NH_2)_2 + H_2SO_4 + SO_3 = 2NH_2SO_3H + CO_2$. It is used in analytical chemistry as a primary standard for acidity, nitrogen and sulphur, as well as for removal of nitrous acid from solutions.

Preparation and properties of the trisulphonate

To examine the properties of the trisulphonate, a quantity was prepared. A small amount was obtained by passing SO_2 through a solution of KOH containing KNO_2, but a greater yield was obtained by adding

an approximately molecular amount of sodium nitrate in solution to a concentrated solution of sodium metabisulphite, the mixture being kept in a cooling bath to counteract the considerable rise in temperature. The mixture was poured into an excess of KCl solution, when a large quantity of the potassium trisulphonate was at once thrown out in the form of white silky crystals. These were separated by Buchner filtration and washed, followed by pressing on an unglazed plate and drying in a warm air current and in a desiccator (heating decomposes the salt by hydrolysis).

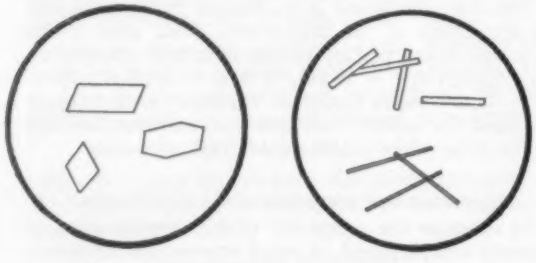
The salt was sparingly soluble in water, giving a solution which hydrolyses very easily to the disulphonate. This occurs almost at once when heated, the solution becoming acid on liberation of potassium hydrogen sulphate. Similarly the solid salt becomes sour in a few days if not quite dry. Other properties are indicated in the table below.

Comparative behaviour of the three potassium sulphonates

	$N(SO_3K)_3$	$NH(SO_3K)_2$	NH_2SO_3K
Solubility in water	Sparingly soluble	Sparingly soluble	Readily soluble
Stability to hydrolysis in neutral solution	Very unstable	Stable	Stable
Reagent			
Cold $BaCl_2$	No precipitate	No precipitate	No precipitate
Hot $BaCl_2$	Fairly rapid precipitation	Very slow precipitation on continued boiling	No precipitate
$Ba(OH)_2$	No precipitate	White flocculent precipitate	No precipitate
Basic lead acetate	White flocculent precipitate	White flocculent precipitate	No precipitate
HNO_2 ($NaNO_2$ + HCl)	Decomposition to nitrogen and sulphate		

Origin of the Ash Constituent

Since the presence of potassium imido-disulphonate has been shown by analysis, any sulphamic acid present is clearly the product of its hydrolysis; the question remains as to whether the original precursor is the disulphonate, trisulphonate or even a complex with another substance. Evidence that the substance is, in fact, the disulphonate is given by microscopic examination of the crystals shed from the sugar crystal, since the disulphonate and trisulphonate crystals are easily distinguishable under the microscope. In some middle and low-product sugars, however, some crystals of rectangular, almost cubic shape have been seen; these may be a form of trisulphonate.



$NH(SO_3K)_2$ $N(SO_3)K_3$

Fig. 3

Information about the distribution of the compound in the sugar end of the factory is scanty and not very reliable. The estimate given below is the best that can be made with the information available.

Evaporator thick juice	very little
White sugar	rich
Low product sugar	very rich
Molasses	little

These proportions are perhaps not very surprising considering the very limited solubility of the disulphonate.

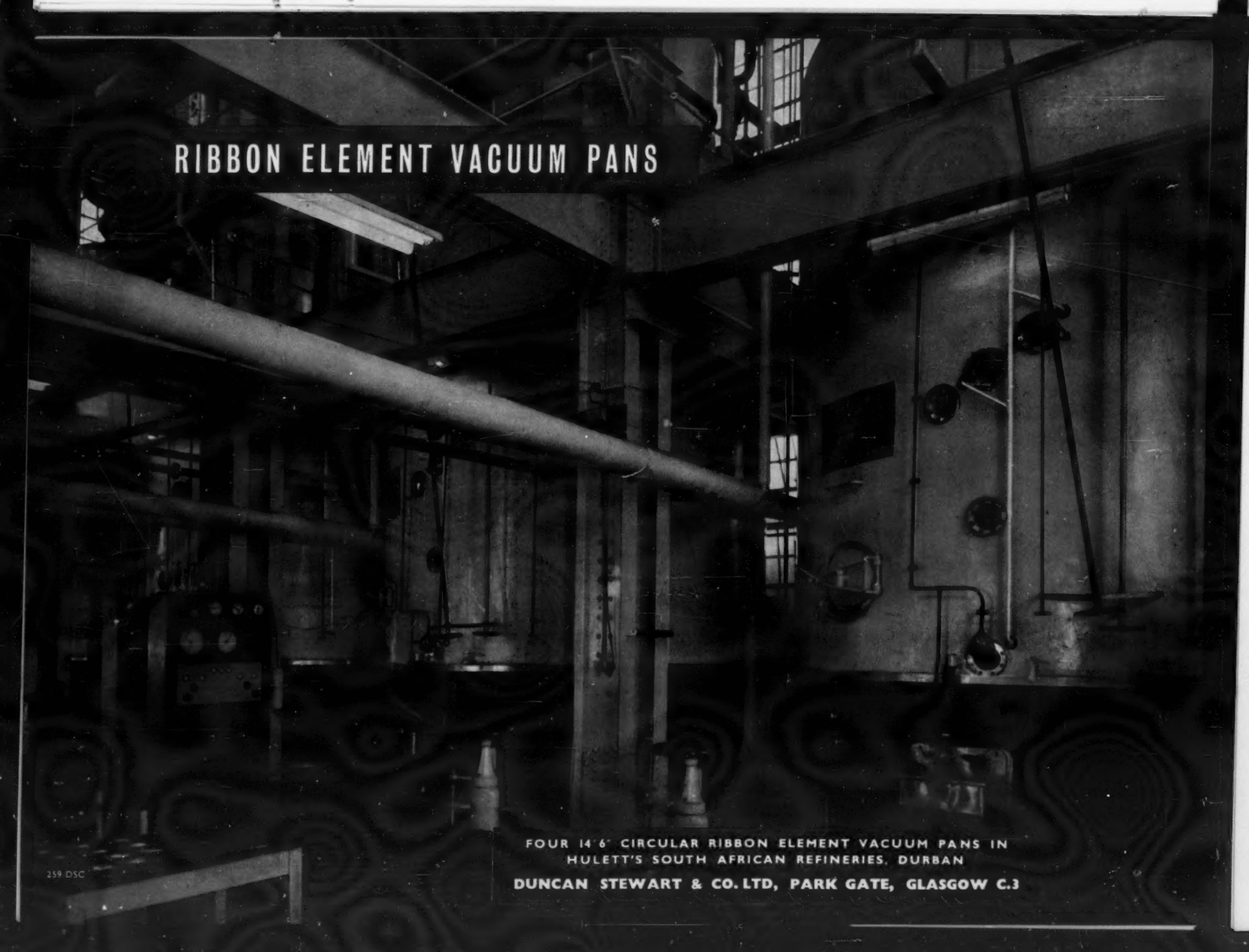
Two methods of formation of imido-disulphonate (IDS) have been quoted, but apart from the fact that the specific ingredients necessary for the reactions are known to be present in the process there is little support for the idea that either actually occurs to anything like the extent necessary to account for the quantities of IDS. The combination of SO_3 and ammonia could conceivably occur by passage of airborne ammonia over the burning sulphur in the ammoniacal vapours of the sulphur tower, but the process is hard to imagine.

The interaction of KNO_2 and K_2SO_3 to give the trisulphonate receives some support from the fact that nitrites are known to be present in the condenser waters as a result of the action of nitrifying bacteria on ammonia. The factory clarified juices between first carbonatation and sulphured thin juices have in the past given blue colours with starch/iodide/acid mixtures. Although little attention was paid at the time to this, it is now confirmed by up-to-date analytical methods that a certain amount of nitrite is present. (N.B.—the iodine reaction is not specific for nitrites, but does indicate the presence of an oxidant, which appears to be necessary to bring about the formation of the compound.)

The limited solubility of the disulphonate, its stability in solution and the ease with which it crystallizes no doubt explain its prevalence in all three grades of sugar. At the same time, it appears that some hydrolysis is going on all the while, the disulphonate molecule breaking down to one of monosulphonate and one of $KHSO_4$. The monosulphonate, being fairly soluble, would not be expected to crystallize in the sugar but to pass into the syrups and molasses with the $KHSO_4$. It would therefore presumably cause no embarrassment to the process apart from some acid formation.

Tentative explanation of the sudden appearance of the abnormal ash

It is assumed that there is a more or less steady intake of nitrite to the process through the action



FOUR 14'6" CIRCULAR RIBBON ELEMENT VACUUM PANS IN
HULETT'S SOUTH AFRICAN REFINERIES, DURBAN

DUNCAN STEWART & CO. LTD, PARK GATE, GLASGOW C.3

259 DSC

SINCE 1840

SAVALLE

Distillation—Rectification—Dehydration
Complete Distillery Plant

Photo. : W. NURNBERG

PURE YEAST
PROPAGATION APPARATUS

NEW BOOKERS' DISTILLERY AT
UITVLUGT, BRITISH GUIANA

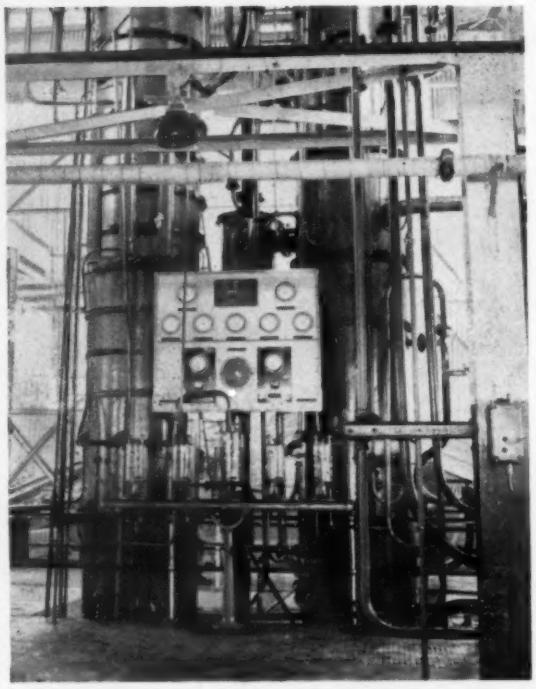


Photo. : W. NURNBERG

OPERATIVE FLOOR
AND STILL COLUMNS

NEW BOOKERS' DISTILLERY AT
UITVLUGT, BRITISH GUIANA

LEPAGE, URBAIN & Cie.

105 Rue de la Convention, Paris,
FRANCE

Telephone: LEC 50-02 *Cables:* ALEPAGE, PARIS

of nitrifying bacteria on the ammonia of the condenser water (it is possible that the beets may supply nitrite, although we have no evidence of this).

It is suggested that the nitrite in the alkaline sulphiation thin juice reacts with the SO_2, forming trisulphonate which at once breaks down into disulphonate, the latter passing into solution to the sugar end and normally out into the molasses. During its passage through the sugar end it is partly hydrolysed to the monosulphonate.

The rate of discharge of the disulphonate by way of the molasses will be limited by its solubility, and therefore if the rate of intake begins to exceed this, or if conditions become less favourable for hydrolysis to the mono-salt (perhaps at a higher pH), then the disulphonate starts to crystallize in the after-product sugar and gradually builds up its concentration backwards through the middle product until it eventually reaches crystallizing point in the white pans. At this stage it begins to co-crystallize with the white sugar.

Analytical Considerations

As a result of the study of the compound, the following simple routine tests have been designed to detect IDS in white sugar:

1. Shake the sugar with dilute BLA; a white flocculent precipitate occurs with IDS.
2. Shake the sugar with ammoniacal $BaCl_2$; a white flocculent precipitate occurs.
3. Measure the electrical conductivity; it is abnormally high in the presence of IDS.
4. Microscopic examination of a crystal in KCl solution; separation of crystals of IDS is seen as the sucrose dissolves.
5. Confirmatory test—add $BaCl_2$ to a cold solution; no precipitate occurs until HCl is added and the mixture boiled.

A useful spot test for abnormal ash has been developed. The sugar is shaken with about twice its volume of dilute BLA. If abnormal ash is present an immediate flocculent white precipitate is obtained. Normal sugar gives at most a very slight turbidity. (Note: the dilute BLA solution, made up with distilled water, should be allowed to stand for about 2 days to allow any carbonate to settle.) This test is now being carried out at regular intervals in the Corporation's warehouses during the loading of the sugar; any sample giving the abnormal reaction is at once brought to the laboratory for a conductimetric ash determination.

For quantitative analysis, there are three sulphur groups to consider: sulphate, imido-disulphonate and sulphamate (monosulphonate). The procedure at present is as follows:

Sulphate.—Add neutral $BaCl_2$, treat the filtered precipitate with HCl and re-filter. Determine the weight of $BaSO_4$.

Disulphonate.—Add $Ba(OH)_2$, filter and wash the precipitate; treat it with HCl + $NaNO_2$; filter and determine the weight of $BaSO_4$. This gives sulphate *plus* disulphonate.

Sulphamate.—Treat with HCl + $NaNO_2$ and then with $BaCl_2$. Determine the weight of $BaSO_4$. This gives sulphate *plus* disulphonate *plus* sulphamate.

Prevention of Disulphonate Crystallization in the White Sugar Pans

The behaviour of after-product sugar with high IDS content, under lime/CO_2 treatment, was examined. The sugar was dissolved to give a solution of about 11°Bx and treated with milk of lime to the extent of about 1·5% CaO by volume of juice. It was then gassed with CO_2 to about pH 11. After filtration the sludge and juice were separately examined for disulphonate content. The following results were obtained:

After-product sugar ..	0·42% disulphonate (≡0·32% SO_4'')
Filtered juice	no disulphonate no sulphate monosulphonate (≡0·16% SO_4'' on sugar)

It may be concluded from these results that the disulphonate is either removed by the sludge or broken down to the (harmless) monosulphonate. Further, the high total sulphate in the sludge shows that all the sulphate in the sugar has been removed also. Confirmation of this important result will be sought later, but there is not much reason to doubt the conclusion.

Advance information of the build-up of disulphonate concentration in the sugar end may be obtained by extremely simple chemical tests and microscopic examinations of the grain of the low-product strikes. On finding that the disulphonate is beginning to build up, a few after-product strikes should be melted and sent back to the raw juice to be subjected to lime/CO_2 defecation. This should result in the removal of the disulphonate from the strikes and thus relieve the concentration in the sugar end and prevent the crystallization of the salt from spreading back to the white pans.

The success of this scheme is predicated on the truth of the following assumptions: (a) that the backwardly-directed build-up in the sugar end occurs according to the theory, and (b) that the after-product sugar when mixed with the raw juice and defecated simultaneously with it behaves in the same manner as it does in solution by itself, as in the experiment described above.

Examination of white sugar, low product sugar and corresponding molasses

The following are the disulphonate contents of typical samples of these products taken during a period of high ash content and examined by the method previously mentioned.

For convenience the disulphonate is expressed in each case as the percentage of SO_4'' found.

White sugar	0·19%
Low product sugar	0·32%
Molasses*	0·56%

* The sulphate content (as SO_4'') was 0·42% and the monosulphonate content (also as SO_4'') was 0·24% on this sample.

The specific conductance of a 25% solution of the white sugar was 515 micromhos at 20°C which compares with a specific conductance of only 36 micromhos for a similar solution of white sugar having a normal ash content.

Conclusion

It is concluded that the cause of the abnormally high ash in the white sugar during the period 12th–21st January 1957 was the salt potassium imidodisulphonate (IDS). This compound has, in fact, been found previously in molasses, as reported by Veibel & Brieghel-Muller[1].

(to be continued.)

RECOMMENDATIONS OF THE PAKISTAN SUGAR COMMISSION

By Dr. H. KAMPF, Dr.Tech.Sc., F.R.I.C.

A REPORT on the various problems facing the sugar industry in Pakistan has recently been published by a ten-man Sugar Commission, under the Chairmanship of Dr. Mian Afzal Husain (formerly Vice-Chancellor, University of the Punjab, Lahore), which was set up by the Government of Pakistan in 1957.

The main terms of reference of the Commission were:

(i) Review of the present acreage, production of cane, recovery percentage and manufacturing capacity of mills with actual outturn.

(ii) Economics of the production of refined sugar in Pakistan as compared with major sugar-producing countries.

(iii) Future expansion of the industry, keeping in view the cost of refined sugar to consumer and expenditure on foreign exchange either on the imports of machinery or the import of refined sugar.

(iv) Economics of the manufacture of local sugar such as "gur" and "khandsari" as compared with factory-produced refined sugar.

(v) Possibility of increasing the production of beet sugar.

(vi) Use of factory molasses for the production of glycerine, power alcohol etc.

(vii) Recommendations for the future expansion of area and production of sugar.

The Commission addressed a detailed questionnaire to all those interested in the sugar industry, and many of its recommendations are based on the replies received, from cane growers, sugar mill owners, sugar technologists, agronomists and economists. The members of the Commission toured both wings of Pakistan, visited all the sugar factories and cane growing areas and questioned a large number of farmers and sugar men. The Chairman of the Commission went to Hawaii in 1958 to study the cane sugar industry there and visited beet farms and beet sugar factories in the United States. He also attended the International Sugar Conference in Geneva in the same year and visited Malaga in the south of Spain where sugar cane and sugar beet are grown in the same area and processed in the same factory.

The report states that the present capacity of the existing 14 cane sugar mills and the 2 mills under construction in Lyallpur and Tando Mohammed Khan is as under:

West Pakistan	140,000	tons of white sugar per season
East Pakistan	85,000	,, ,, ,, ,,
Total	225,000	,, ,, ,, ,,

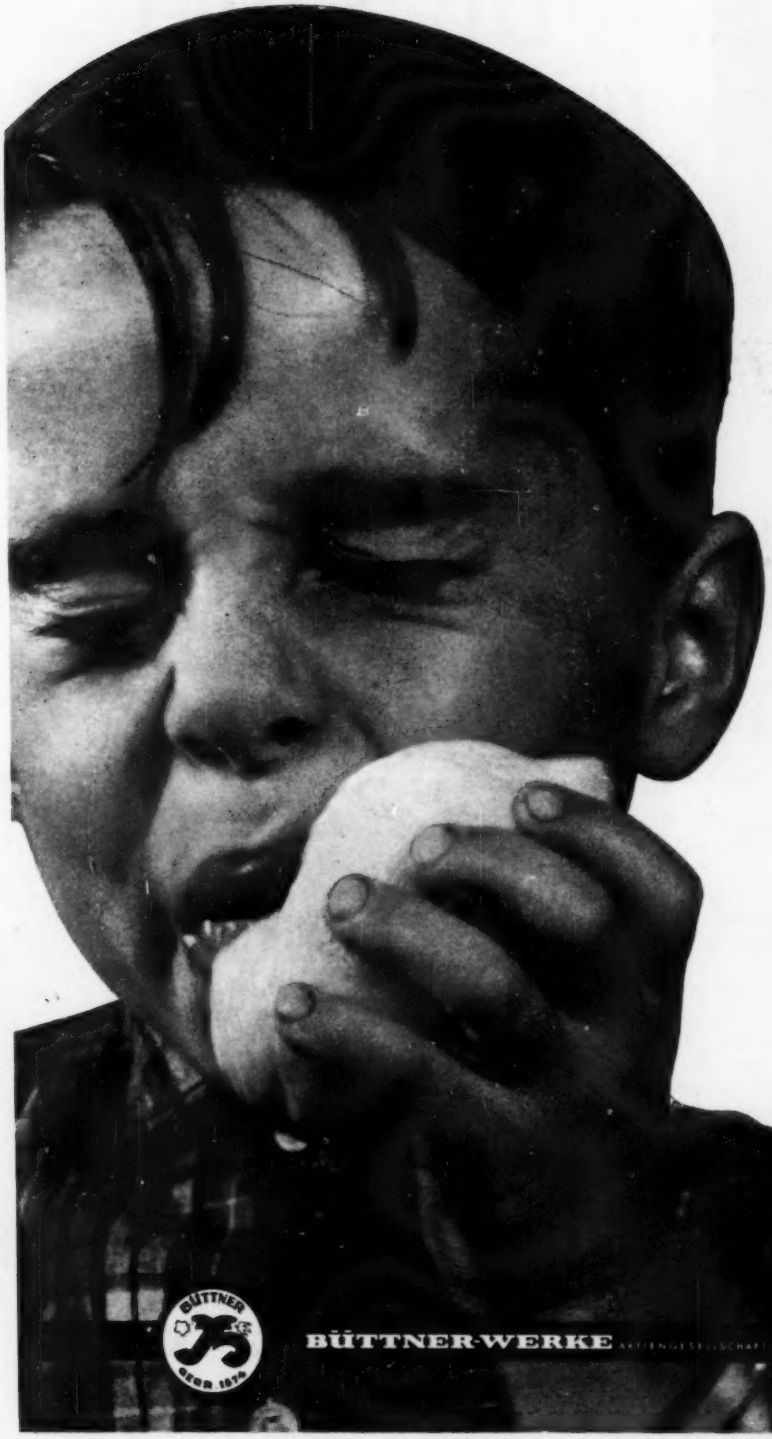
The Commission recommended a target of 500,000 tons of white sugar by 1965 as not excessive. The Government, bearing in mind the foreign exchange required for other developmental activities, have come to the conclusion, however, that a target of 300,000 tons would be more realistic. In order to reach this production aim during the "2nd Five Year Plan 1960–65" the following installations will be added:

West Pakistan	45,000	tons of white sugar per season
East Pakistan	30,000	,, ,, ,, ,,
Total	75,000	,, ,, ,, ,,

The economical crushing capacities of new mills, is 1,500 to 2,000 tons of cane per day in West Pakistan and 1,000 tons in East Pakistan, so that 8 more sugar mills are to be set up, i.e. 4 in West and 4 in East Pakistan.

The Government have also agreed to provide foreign exchange to the extent of five million Pakistani rupees (£375,000) for the installation of 16 modern "khandsari" units in the two wings of Pakistan.

[1] *Socker Handl.* II, 1946, **2**, 373; *I.S.J.*, 1947, **49**, 329.



A sour bite!

It just doesn't do without sugar.

For all its importance, sugar is normally taken for granted. When sweetening fruit or confections, who would ever think of the manifold chemical and technical processing sugar must undergo? Who knows that sugar must be dried and that the drying process is most critical in obtaining a high quality product?

Only gentle drying will preserve the luster and sharp edges of sugar crystals. And it is just these sharp edges and this brilliance which are so important to the discriminating buyer because they are the true symbols of sugar quality.

This is the reason why Sugar Experts all over the world insist upon the

Buttner Turbo Tray Dryer and Cooler

to be sure of

a gentle drying process for their sugar crystals

lowest power and heat consumption

a continuous and trouble-free operation

minimum supervision

the possibility of either bagging the sugar or storing it in silos immediately after the drying and cooling process.

Please ask for detailed literature and the advice of our engineers who will be with pleasure at your service.

Subsidiary Companies:

U. S. A.: Buttner Works Inc.,
52 Vanderbilt Ave., New York 17, N. Y.

Canada: Buttner Works (Canada) Ltd.,
P. O. Box 688, Montreal P. Que.

Licensee: for Great Britain and South Africa:

Buell (1952) Limited,
3, St. James's Square, London S. W. 1

Agencies in all Central and South American Countries, India, Japan etc.

BÜTTNER

BÜTTNER-WERKE AKTIENGESELLSCHAFT KREFELD-UERDINGEN

The DE SMET CONTINUOUS DIFFUSER

. . . is the only one which does not submit the cossettes to any agitation during diffusion

The DE SMET DIFFUSER is, in fact, a continuous filter across which the diffusion juice passes some twenty times in counter-current.

The DE SMET DIFFUSER is the only one which has permanent cleaning of the filtering surfaces.

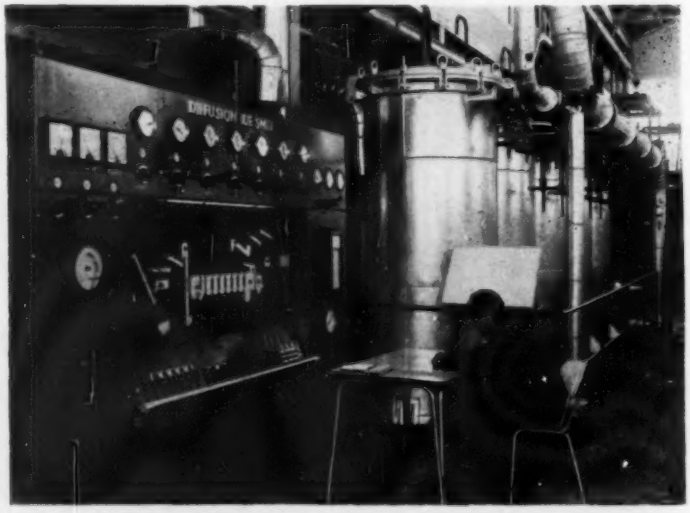
- No coloration of the pulp
- No cossette destruction
- No loose pulp in the juice
- No blockages
- No possibility of infection

Complete control of temperature and pH all along the diffuser.

Juice purity greater than that of battery juice. Exhaustion 0·15—0·20%
Draft less than 105% Steam consumption extremely small.

JUICE CIRCULATION INDEPENDENT OF DRAFT

WIDE RANGE OF BEET SLICE



EXTRACTION CONTINUE DE SMET

SOCIETE ANONYME

38 AVENUE DE FRANCE

ANVERS **ANTWERP**

BELGIUM

A beet diffusion plant has been added to the Charsadda cane sugar mill, which processed 23,867 tons of locally grown sugar beet during the first campaign in 1960 after the cane season had ended. The Government have accepted the recommendation of the Commission that further expansion of the beet sugar industry should depend largely on a very careful scrutiny of the results of the beet diffusion plant at Charsadda. The West Pakistan Government have also been requested to examine the position of the cultivation of sugar beet in relation to the cropping pattern of other crops in the North West Frontier region. In the same area, which will be served by the new irrigation scheme of the Warsak Dam Project, a small cane sugar factory of a daily crushing capacity of 500 tons of cane might be installed, but before taking a final decision data about the occurrence and frequency of frost must be collected.

The report records that the average yield of sugar cane per acre in Pakistan is only one-seventh of that obtained in Java and Peru and one-ninth of that in Hawaii. During the last ten years the cane acreage in West Pakistan has been doubled while in East Pakistan it has remained about the same. Despite this increase of the cane area Pakistan has spent 560 million rupees (£42 million) during the past 12 years on the import of sugar. To obtain higher returns of sugar per acre, cane breeding work at the cane research centres at Lyallpur and Murree in West Pakistan and at Ishurdi in East Pakistan will be strengthened and varietal studies at the cane research stations at Mardan and Lower Sind will be increased.

The Commission recommended the linking of the cane price with the recovery percentage and considered Re 1/8 per maund of cane with 8·5% recovery a reasonable price. In view of the administrative difficulty the Government could not accept this recommendation but decided that the cane price for West Pakistan should be reduced from Rs 1/10 per maund to Rs 1/8 per maund for 1959/60 and Rs 1/7 per maund for three years thereafter for delivery at the factory gate. In East Pakistan the prices have been reduced from Rs 2 to Rs 1/14 for "gate" cane for the 1960/61 season. Although the cane price is still on the higher side in East Pakistan, it is partially compensated by the higher percentage of recovery in that area.

As suggested by the Commission the Provincial Governments will prepare a master plan for the development of cane in order to concentrate cane around the sugar mills and to increase the cane yield without enlarging the acreage under cane. Furthermore the Provincial Departments of Agriculture have been directed to ensure the supply of improved implements and seeds, better distribution of irrigation water, regular allotment of cheap manures and fertilizers and plant protection service. A plant for the formulation of pesticides will be set up in each wing of Pakistan.

The Government have accepted in principle the recommendation for the allocation of adequate funds for the organisation of research and development and it has been decided that technical research and training in sugar technology should form part of the programme of the new Agricultural University. The Central Government will also explore the possibility of the utilization of final sugar molasses as cattle feed and fertilizers and investigate whether candy can be produced from date palm sugar. To boost the export of confectionery and products of the fruit processing industry, the Government will allow the supply of sugar at reduced rates to certain manufacturing firms and rebate in taxes will be given at the time of export.

Other points in the Sugar Commission Report, as accepted by the Government, were:

Development of joint or co-operative farming in the mill areas for the production of sugar cane, with the farmers and mill owners sharing the enterprise; provision of cheap and efficient transport facilities for cane growers to bring their produce to the mills and finally the manufacture of sugar mill machinery within the country. In this direction a beginning has been made with the conclusion of an agreement between the Karachi Shipyard Works and Engineering Co. Ltd. and a Dutch firm to manufacture this machinery in Karachi.

The report considered the present retail price of sugar in Pakistan high and thought that a fair retail would be Rs 1 per seer including all taxes. It is disappointing for the consumer that the Government have found it impossible to reduce the existing price of Rs 1/5 per seer as they incur heavy losses in subsidising the sale of foodstuffs such as wheat in the country. Also the excise duty of Rs 5/2/4 per maund of refined sugar will not be reduced and as "khandsari" sugar is selling at a higher rate than the controlled white sugar, the Government decided not to abolish the nominal duty of eight annas per maund of "khandsari."

The Sugar Commission opposed the decontrol of prices and distribution of sugar till sufficient sugar is produced to meet the minimum requirements of the country.

On the recommendation of the Sugar Commission the Government of Pakistan have decided to set up a Central Sugar Cane Committee to deal with all aspects of sugar cane research and development. This 15-man Committee, which will be headed by the Food Secretary and Agricultural Secretary, will also advise the Government from time to time regarding the fixation of cane and sugar prices and devise measures aimed at the improvement and the stability of the sugar industry at all stages.

Beet sucrose content rise by radiation.[1]—It is reported that after irradiation of beet seeds in a laboratory at Louny, Czechoslovakia, using a radio-isotope, a 3% increase in sugar content was achieved.

* * *

Record sugar production in Costa Rica.[2]—The Chamber of Sugar Growers reports that centrifugal sugar production for the 1959/60 season is a record 62,500 metric tons.

[1] *Zuckererzeugung*, 1960, **8**, 230.
[2] *Willett & Gray*, 1960, **84**, 339.

Bulk sugar handling at the Biscom (Binalbagan-Isabela Sugar Co. Inc.). S. Z. URETA. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 143–149.—In order to meet a commitment for supplying bulk sugar before the necessary handling plant was available, the sugar was bagged (58 kg per bag) and sent to the warehouse by chain elevators and conveyors, where the bags were emptied. The loose sugar was taken by rail in bulk box cars to Hinigaran docks for shipment of 1000 tons/day. By installing an elaborate belt conveyor system handling 150 tons/hr, shipment of 2000 tons/day is envisaged.

* * *

Scoring the performances of Philippine sugar factories. T. R. ANCHETA. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 221–231.—Performance data of 23 mills for 1952/53 and 1957/58 are expressed in terms of reduced extraction, reduced boiling house recovery (ESG) and reduced overall recovery (ESG).

* * *

Sugar house equipment performances in the Philippines. 1956–57 crop. J. P. STO. DOMINGO. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 252–277.—Performance data are tabulated for the equipment in Philippine factories, including juice heaters, clarifiers, filters, evaporators, vacuum pans, crystallizers, high-grade and low-grade centrifugals. Details are also given of the size of the equipment in each factory and graphs are presented of the relationship between filter-cake per sq. ft. of filter area and filter-cake % cane in 21 factories, and of the influence of non-sugars in kg/cu.ft. crystallizer capacity on the final molasses purity.

* * *

Recent improvement at the San Carlos sugar factory. C. M. MADRAZO. *Proc. 6th Conv. Philippines Sugar, Tech.*, 1958, 278–281.—Details are given of new equipment and modification at the factory, besides future modernization plans.

* * *

Behaviour of drought-affected cane during the process of sugar manufacture. D. R. PARASHAR. *Indian Sugar*, 1960, **10**, 55–58.—Performance data are presented for a carbonatation and a sulphitation factory in Bihar, both processing drought-affected cane during 1957. The data for the affected cane are compared with those for 1958/59, when normal cane was processed. In the sulphitation factory (A) the affected cane started the season with a higher Brix and juice purity than normal cane; the purity of the latter increased during the season, slightly exceeding that of the affected cane, although the Brix of the affected cane remained higher. The affected cane deteriorated quicker than the normal towards the end of the season, although on the whole was still superior to the normal cane. In the carbonatation factory (B) similar results were obtained. In both cases rapid deterioration of the affected cane occurred in mid-March. Fibre % cane was unchanged in A and higher for the affected cane in B, while milling figures are about the same. Filtration was more difficult, the recovery % cane was low, with high losses to final molasses, and unknown losses were high.

* * *

Eight years with the rubber belt intermediate carrier. R. LABIOSA. *Sugar J.* (La.), 1960, **23**, (1), 13–14.—Rubber belt intermediate carriers[1] have proved remarkably successful and durable at Central Plata over a period of 8 years.

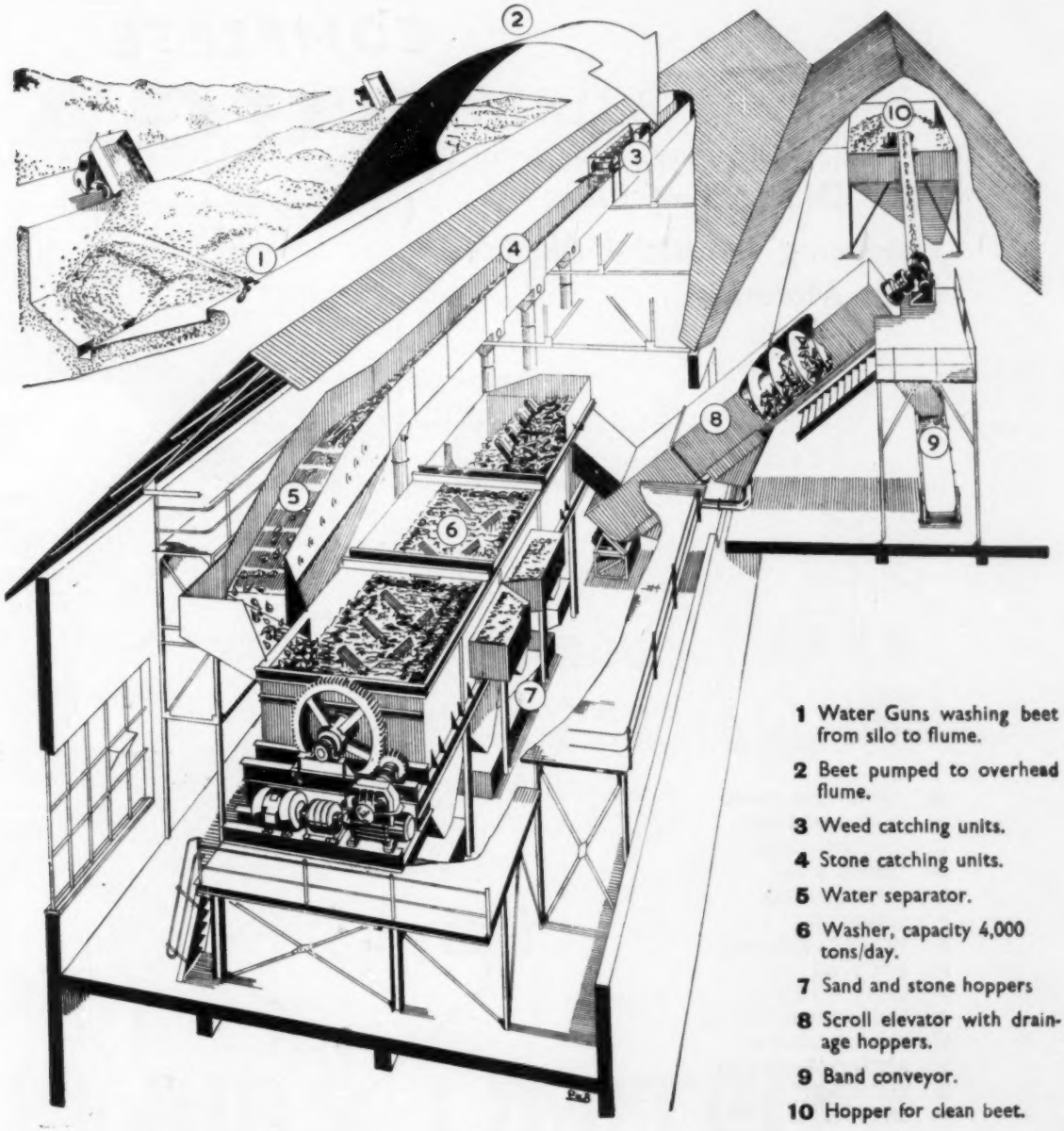
* * *

An automatic cane conveyor control installed at Central Coloso. C. MARTINEZ. *Sugar J.* (La.), 1960, **23**, (1), 54–56.—The control on the main conveyor consists of a "Dynamatic" variable-speed coupling which transmits power by means of an electromagnetic reaction between the driving member and the field assembly, which is connected to a magnetic amplifier control. This control receives signals from three sources: the motors of the two cane knives and an induction regulator linked to the force feed roll of the 1st mill. The cane conveyor is stopped by the induction regulator if the height of the cane mat is such that the grinding rate would exceed 275 tons/hr. The signals from the motors of the cane knives are based on the current demand of the motors, which is dependent on the cane feed from the cane table and/or the auxiliary cane conveyor. As the current increases the speed of the conveyor is reduced. If the discharge valve of the automatic juice scale fails or the 1st bagasse carrier stops, the mill stops. This is brought about by an interlock system described. Two present disadvantages are: feed will continue to the 1st mill even if there is choking at any of the other 5 mills (to be corrected by installing limit switches at the mills); and the magnetic amplifier control integrates the 3 signals, so that even if none of the signals are at maximum amplitude the cane conveyor will stop or slow down. This will be remedied by adding a discriminating circuit responding only to the highest of the 3 sources.

[1] *See I.S.J.*, 1959, **61**, 124.

BEET WASHING PLANT

AS SUPPLIED TO THE BRITISH SUGAR CORPORATION LTD



1 Water Guns washing beet from silo to flume.

2 Beet pumped to overhead flume.

3 Weed catching units.

4 Stone catching units.

5 Water separator.

6 Washer, capacity 4,000 tons/day.

7 Sand and stone hoppers

8 Scroll elevator with drainage hoppers.

9 Band conveyor.

10 Hopper for clean beet.

COCKSEDGE & Co. LTD

Telephone: **Ipswich 56161 (5 lines)**

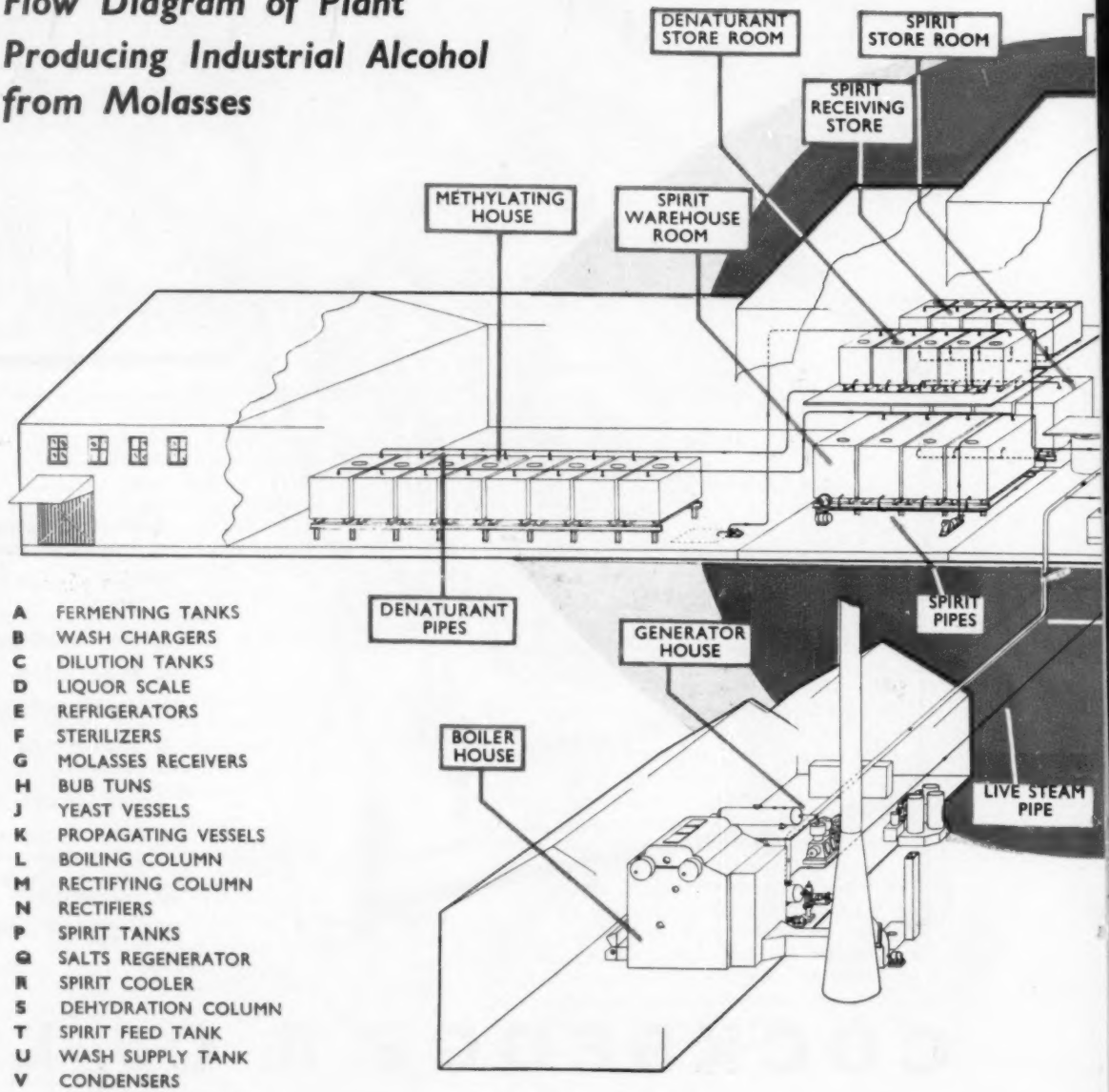
IPSWICH ENGLAND

Telegrams **'Cocksedge, Ipswich'**

BLAIRS

COMPLETE
SUGAR

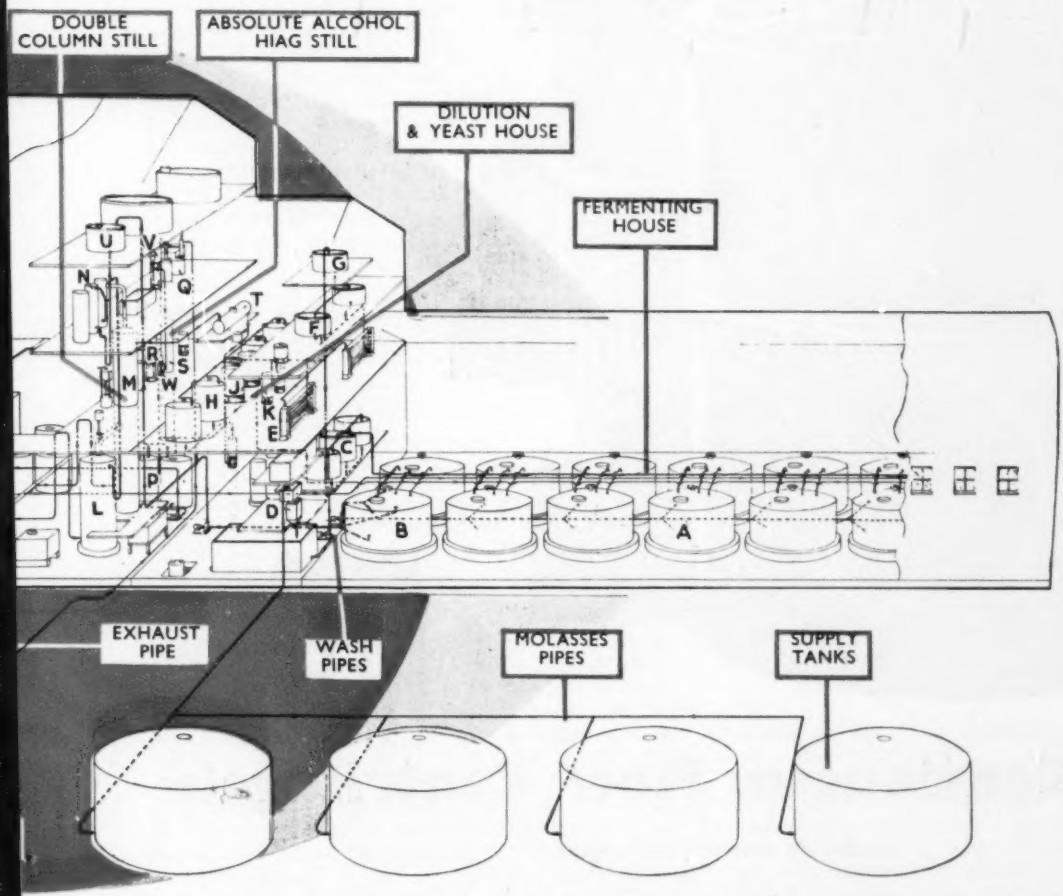
Flow Diagram of Plant Producing Industrial Alcohol from Molasses



A	FERMENTING TANKS
B	WASH CHARGERS
C	DILUTION TANKS
D	LIQUOR SCALE
E	REFRIGERATORS
F	STERILIZERS
G	MOLASSES RECEIVERS
H	BUB TUNS
J	YEAST VESSELS
K	PROPAGATING VESSELS
L	BOILING COLUMN
M	RECTIFYING COLUMN
N	RECTIFIERS
P	SPIRIT TANKS
Q	SALTS REGENERATOR
R	SPIRIT COOLER
S	DEHYDRATION COLUMN
T	SPIRIT FEED TANK
U	WASH SUPPLY TANK
V	CONDENSERS
W	OBSERVATION GLASS

FACTORIES & REFINERIES

DISTILLERIES, ABSOLUTE ALCOHOL & CHEMICAL PLANTS



BLAIRS LIMITED

WOODVILLE STREET · GLASGOW, S.W. 1

Cables : "BLAZON GLASGOW"

London Office : **38 GROSVENOR GARDENS, S.W.1**

Cables : "Multivap Sowest London"

Fully continuous flow centrifugals of Hein, Lehmann & Co. A.G. are excellently suitable for curing of most difficult massecuites, e.g. C-, final or second product.

Latest modifications in construction allow them to be used also in affining stations.

The fully continuous sugar centrifugal has been perfected after years of research and development by Hein, Lehmann & Co. A.G. These centrifugals, working on the thin-layer principle, have already been copied in spite of application for patent protection. They have been successfully introduced not only in Germany but also in numerous other countries.

Fully Continuous Flow Centrifugals

offer the following advantages:

- continuous working
- reduction of working personnel
- small current consumption, no current peaks
- high output
- light weight
- no special foundations
- vibration-free running
- uniform sugar quality

HEIN, LEHMANN & CO.

Aktiengesellschaft Duesseldorf

Abt. Massentrennung

Telephone: 70201 *Telex:* 0858 2740 P.O. Box 4109

A summary of recent improvements in Puerto Rican factories. D. A. DRAUGHON and J. RODRIGUEZ CHACON. *Sugar J.* (La)., 1960, **23,** (1), 57–61.—A description is given of modifications and new equipment at Central Cortada, Puerto Rican American Sugar Refinery Inc., Central Plata, and Central Aguirre.

* * *

Basis of calculations of ion exchange plant for decolorizing refinery syrups. J. BURIÁNEK and F. DURDÍK. *Listy Cukr.*, 1960, **76,** 126–129.—The calculation of the size of ion exchange columns and of the number for decolorizing refinery syrup is discussed mathematically. The work is based on the use of ion exchangers of the *m*-phenylene diamine type ("Wofatit E" and "Decolorex") and on two methods of treatment, i.e. decolorizing each type of syrup separately, or the cascade method, whereby one and the same exchanger is used for treatment of 1st, 2nd, etc. syrups in sequence before regeneration. The conditions that each method must fulfil are given in mathematical form, although no preference as to method is as yet expressed.

* * *

Method of calculating the output of moist refinery magma (for pressing). I. F. ZELIKMAN. *Sakhar. Prom.*, 1960, (6), 25–27.—A series of equations are derived relating a large number of variables, and a sample calculation of the water content of the magma % massecuite is presented.

* * *

Decolorizing ion exchangers. IX. Evaluation of the ageing of decolorizing ion exchangers. J. ŠTAMBERG and F. KRŠKA. *Listy Cukr.*, 1960, **76,** 129–135.—Ageing tests were carried out on some Czechoslovak resins and on "Wofatit E." Two methods were adopted, one to determine the effect of alkali on the decolorizing capacity and on the swelling capacity, the other to determine the effects of various factors under actual working conditions. With the first method, 10 ml distilled water was added to a known amount of a resin sample of 0·5–1·5 mm particles, 150 ml NaOH preheated to 80°C then being added. The flask containing the sample was then agitated during 5 hr to 80°C in a water-bath. The sample was then washed with water and regenerated with ammonium acetate and water, and the volume reduction of the resin determined, as well as the dry weight swelling capacity, the volumetric and dry weight decolorizing capacity[1]. The results are given as percentage drop on the initial values. The second, cyclic, method was carried out with a "recycler." This comprises a 30-ml column fed with molasses solution, NaOH, HCl and water from storage jars. Flow is regulated by electromagnetic valves, and the controlling mechanism is a thyratron programme device. A micro-filter is also incorporated. The molasses solution (60 g/litre) of 40°St. colour is decolorized and the resin desorbed with 2% NaOH and regenerated with 1·5% HCl. Each cycle takes 90 min. Full details are given of the results after 20 cycles, showing that the "Wolfatit E" resin suffered less drop in capacity than the other resins, although its initial capacity was somewhat lower. It was found that the resins age 8 times faster in the "recycler" than under normal working conditions.

* * *

Intensification of the process of drying refined sugar. B. M. BRAGINSKAYA, I. S. LEIBMAN and M. T. MOLCHADSKII. *Sakhar. Prom.*, 1960, (6), 27–28.—The statement that increased rate of flow of steam in the heating elements of a vacuum dryer will increase capacity is criticized, as the effect of increased flow rate, suitable only where the heating tubes are of reduced dia., is dependent on the efficiency of steam condensation and condensate removal.

* * *

Automatic recording device for determination of the rate of destruction of refined sugar cubes in water under pressure. A. A. GROKHOVSKII and A. A. SOROKA. *Sakhar. Prom.*, 1960, (6), 38–40.—A clockwork mechanism has been attached to a "Zesi" device for determination of the strength of cubes, and pen for graph plotting. Thus the time taken for a cube to dissolve in water under the pressure of a 1-kg weight is automatically recorded.

* * *

Chemical plant processing sugar cane at Kiangmung on the Pearl River. J. LEKAWSKI. J. MOLENDA and W. TOMCZYŃSKI. *Gaz. Cukr.*, 1960, **62,** 90–104.—The combine, designed and erected by Polish engineers in Kwiantung, is described in great detail with illustrations and some performance data. It is designed to process 3000 tons of cane per day (towards the end of April 1959 a daily maximum of 3600 tons was crushed) as well as produce alcohol, fodder yeast, dry ice and bagasse cellulose. The sugar factory is a carbonatation-sulphitation factory using a 3-boiling system.

* * *

Aluminium alloys as construction materials in the sugar industry. I. PAULIK. *Cukoripar*, 1960, **13,** 113–117.—The advantages of aluminium alloys over aluminium are discussed and results are given of corrosion tests, expressed as weight losses, for various alloys immersed in juice during 84 days. Graphs are also presented of weight loss versus alkalinity, and of the weight loss of the different alloys tested *vs.* time under identical conditions. The risk of corrosion by contact with the nobler metals is underlined.

* * *

Application of electromagnets in sugar sieves. B. BEDINSZKY. *Cukoripar*, 1960, **13,** 118.—The use of a set of electromagnets for iron separation from granulated sugar passing across vibratory screens is discussed with illustrations.

[1] *See I.S.J.*, 1958, **60,** 274.

Separation of the flock from prelimed beet juices. R. VANDEWIJER. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—In an investigation on flock separation, laboratory trials were made to examine the effect of filter cloth, temperature, vacuum, nature of the precoat and the F_k value on the filtration rate of prelimed juice. The last factor is governed by a number of other variables, including the type of pre-liming, diffusion temperature and duration, degree of pulp elimination, etc. Pilot plant tests were made using a rotary vacuum filter of 0·75 sq.m. surface fitted with a scraper blade for removing the deposited flock together with a very thin layer of precoat (a discontinuous precoat procedure). Flow rates achieved with a removal of 0·2 mm of precoat per revolution corresponded to a required surface of 24–30 sq.m. for a factory slicing 1000 tons daily. This was not possible and further experiments were made using a continuous precoat where fresh precoat was added to the surface from which the used precoat had been removed by the scraper. Results here were also unsatisfactory and recourse was made to filtration on a bare cloth. Here again, the charge of flock was insufficient and it was realised that it was not possible to eliminate the clarifier for thickening the prelimed juice. At the same time as tests on flock separation were continued, tests were made on the factors affecting the F_k value, and the technique adopted of adding the lime into the last but one compartment of the pre-limer and carbonatating the prelimed juice in the last compartment, the latter being a method patented by A/S. De danske Sukkerfabrikker[1]. After initial settling, when mud concentration rises, a Dorr-Oliver ultra-thickener was used to hasten thickening. This uses a rotating agitator with vertical blades which create channels for release of juice from between the mud particles. Use of a bare cloth with the thickened flock caused trouble by clogging when compressed air was used to remove the flock layer; this was avoided by using a steam jet (under 0·2 kg/sq.m. pressure), when cleaning became necessary only once a shift. In this way 100 litres of pre-limed juice yielded 88 litres of clear juice and 12 litres of mud containing 75 g/litre of flock. Addition of lime to the clear juice for further purification could be restricted to a total usage of 0·8 g/ml compared with 1·3–1·4 g/ml where the flock was not removed. The limed and carbonatated clear juice was treated satisfactorily in either a hydrocyclone, clarifier or continuous filter, the underflow or mud being passed to a centrifugal where it reached a solids content of 90% and sugar content of 0·2%. Sweetening-off water is thus considerably reduced compared with the normal process. The new process was tested during the short 1959 campaign (5 weeks), much of the time being devoted to comparatively minor modifications. The results were sufficient to show its feasibility on the industrial scale, the lime usage being reduced without sacrificing juice quality. However, modifications are to be made in the 1960 campaign including carbonatation in a continuous Dorr-type gassing tank instead of in the pre-limer and the experimental use of an "Eimcobelt" filter.

* * *

Juice composition in relation to factory performance. A. CARRUTHERS, J. V. DUTTON, J. F. T. OLDFIELD, M. SHORE and H. J. TEAGUE. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—The drought conditions of the summer of 1959, together with rainy weather near the beginning of the campaign, caused the sugar content of the beets to become very high followed by a gradual decline. Analyses of beets before the campaign and factory juices, molasses, etc. during the campaign were made to examine the effect of the weather on the non-sucrose components of the beet. Pre-campaign results showed that amino-acids were relatively high compared with 1958 data[2]. Campaign juice analyses showed that potassium was lower, and sodium was about the same, while amide, amino and betaine nitrogen were higher by 33%, 61% and 24% respectively. The reduction in anions corresponding to the lower potassium content was restricted to anions eliminated in clarification, the non-eliminated chloride ion increasing. The increase in nitrogen, particularly the detrimental glutamine (amide-N) increase, together with the anion changes combined to make processing more difficult and the use of more soda-ash was necessary to maintain a proper pH in the sugar end while keeping lime salts as low as possible—this reduced the second carbonatation juice purity and so increased molasses production. The protein content of raw juice was half that of 1958/59 and consequently its removal in clarification resulted in a correspondingly lower purity rise. A relatively greater increase in the asparagine content was noted as compared with the other amino acids. Molasses analyses showed a slight fall in potassium content towards the campaign end while sodium remained steady as did pyrrolidone carboxylic acid. Betaine was higher than in 1958/59 and reached a peak towards the middle of the campaign. Invert sugar in some factories was higher than usual, this being associated with difficulties in pH control. Mould

[1] Dutch Patent No. 79849.
[2] *I.S.J.*, 1959, **61**, 376.

COMPLETE ALCOHOL PLANTS *by APV*

APV have been responsible for the development, design, construction and commissioning of complete alcohol plants all over the world. They have the experience, resources and organisation to deal with complete projects for the production of all types of alcohol from molasses, as well as from dates, rice, grain and other raw materials.

Alcohol projects undertaken by APV in recent years include the following:—

EAST INDIA DISTILLERIES LTD., INDIA.
900,000 galls./year of rectified spirit from molasses.

BURMA PHARMACEUTICAL INDUSTRY, BURMA.
750,000 galls./year of alcohol and 330,000 lb./year of dried medicinal yeast from rice.

COLONIAL SUGAR RECTIFYING CO., AUSTRALIA.
2,100,000 galls./year of absolute alcohol or rectified spirit.

MODERN CHEMICAL INDUSTRIES LTD., IRAQ.
360,000 galls./year of rectified spirit from dates.

SUGAR MANUFACTURERS' ASSOCIATION, JAMAICA
2,100,000 galls./year of absolute alcohol from rum.

MACNAB DISTILLERIES LTD., SCOTLAND.
360,000 galls./year of grain whisky.

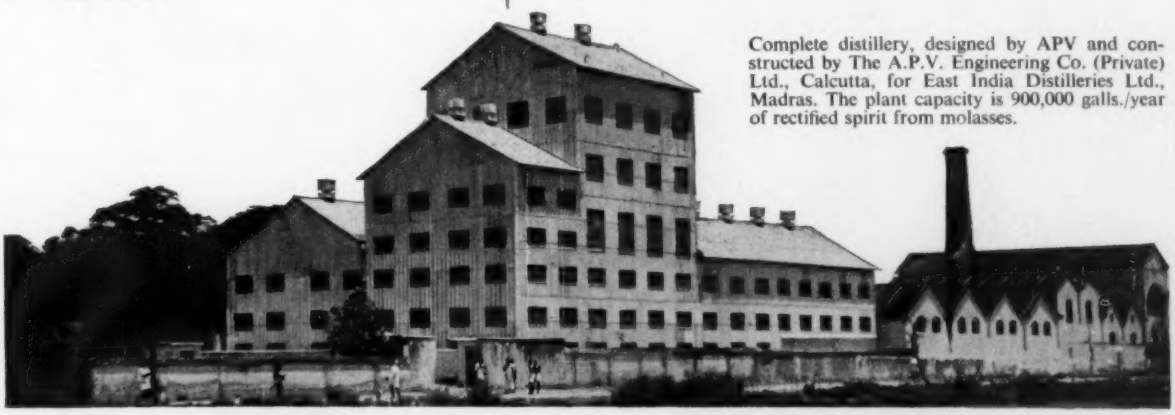
PREMIER SUGAR MILLS, PAKISTAN.
Fermentation plant for 600,000 galls./year distillery.

DYER-NEAKIN LTD., INDIA.
360,000 galls./year of high quality potable rectified spirit from molasses.

WRAY & NEPHEW LTD., JAMAICA.
180,000 galls./year of gin spirit from molasses.

S. A. DAVSON & CO. LTD., BRITISH GUIANA.
360,000 galls./year of rum from molasses wash.

BEN NEVIS DISTILLERY LTD., SCOTLAND.
180,000 galls./year of grain whisky.



Complete distillery, designed by APV and constructed by The A.P.V. Engineering Co. (Private) Ltd., Calcutta, for East India Distilleries Ltd., Madras. The plant capacity is 900,000 galls./year of rectified spirit from molasses.

APV **CHEMICAL ENGINEERING DIVISION**

Contractors and engineers to the fermentation and alcohol distillation industries. Plants for grain cooking, saccharification, yeast culture, fermentation, CO_2 recovery, etc. Stills and other equipment for the manufacture of all types of alcohol including whisky, gin and rum.

THE A.P.V. COMPANY LIMITED · MANOR ROYAL · CRAWLEY · SUSSEX

TELEPHONE: CRAWLEY 1360. TELEX: 8737. TELEGRAMS: ANACLASTIC, CRAWLEY

What have these "warriors' shields"
got to do with better product performance?

Among the hundreds of different types of particles found in Celite diatomaceous earth are these "warriors' shields." Shown here magnified hundreds of times, are, from left to right, *Navicula splendida, Raphoneis amphiceros* and *Navicula lyra.*

They're particles of CELITE

that produce a porous, free-filtering cake, giving longer filtration cycles and brilliantly clear syrups.

Celite's unique diatomite structure is shown in this photomicrograph. The infinite variety of particle shapes and sizes gives Celite its exceptional performance characteristics as a filter-aid in the Cane and Beet Sugar Industries.

JOHNS-MANVILLE JM PRODUCTS

For further information about Celite, simply write Johns-Manville International Corp., Box 60, New York 16, N.Y., U.S.A. *For England and Continental Europe:* Johns-Manville Co. Ltd., 20 Albert Embankment, London, S.E.11.

infection of damaged roots also raised invert content to as high as 0·5%. Raffinose rose during the campaign but the levels were much lower than in the previous. The presence of higher than usual amounts of "kestose"—total oligosaccharides other than raffinose—was found to be due to their presence in the beets, including healthy roots, and not due to formation in the process. Modifications have been made to the analytical techniques used previously[1], and one has led to further knowledge of beet nitrogen constituents. Acid hydrolysis of pyrrolidone carboxylic acid, separated from sugars and amino acids by ion exchange, always gave higher results than alkaline hydrolysis. This was found to be due to the the presence of ammonia which, since it is not held by the resin used, must have been derived from other substances. Analysis of the acid eluate revealed the presence of urea and allantoic acid while raw juice was shown to contain allantoin from which both were obtained by hydrolysis during processing.

* * *

Methods of waste water treatment. Legal aspects and physical treatment. O. H. PHIPPS. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—The legal aspects of water pollution in the U.K. are governed by a number of Acts of Parliament as well as by Common Law, and the provisions and effects of these are reviewed and discussed with particular reference to pollution with sugar factory wastes. The types of waste waters, their quantities and strengths (B.O.D. values) are tabulated and the minimization of the quantities by re-use are described. Because of the amount of water taken into the factory as a beet constituent and as rain, mud covering the roots, etc., it is considered that the weight of polluting matter for treatment and disposal can not be reduced to much less than a fifth of that discharged at a fresh water factory. The screening and returning of process water to diffusion is discussed—with a well-designed circulatory system of small capacity and efficient removal of suspended solids, there should be no difficulty in re-using all process water. Treatment of transport water is generally by screening, followed by sedimentation; the types of sedimentation tanks and lagoons used in the U.K. are described. Re-use of condenser water is comparatively simple, only cooling being involved. Cooling towers are considered more advantageous than lagoons or spray ponds, but blocking by fungus is a danger which must be avoided by chlorination and by use preferably of the open-frame natural draught type of tower. Lime sludge drainage water can be mixed with more filter cake or stored with other surplus water for subsequent treatment. It can be eliminated by transporting "dry" filter cake on conveyor belts. Small individual recirculation systems are recommended for tare-house spray washer water, boiler house and pulp house ash fluming waters. Lime kiln gas washing water and turbine oil cooling water can form part of the condenser water system.

Ion exchange in the sugar industry. A. CARRUTHERS and J. F. T. OLDFIELD. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—A detailed and thorough review is made, describing first the basic features of the principal types of resin, techniques of deionization and resin regeneration, the special properties of ion exchangers in beet sugar processing, deionization capacity of resins, resin and regnerant cost for the strong cation/strong anion combination, and various means intended to reduce regeneration costs. Ion exclusion, the Assalini, S.C.C., Vajna, and carbonate processes are described and discussed, as well as techniques for calcium-sodium exchange and colour removal, deionization of high quality sugars, and recovery of glutamic acid. The authors conclude that most applications of ion exchange in the sugar industry are unattractive under the present British price conditions, the principal factor against their adoption being the short and uncertain life of the resins and consequent high replacement cost. If really stable resins became available it is probable that ion exchange installations would ultimately become standard equipment for sugar processing.

* * *

Control engineering applied to the British Sugar Corporation. R. M. J. WITHERS and J. E. A. RICH. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—This paper is in three parts, the first covering the theoretical requirements for automatic control and discussing the specification and realization of performance, the nature of the process and plant response, and the compensations which may be realised with available controls. Multi-loop controls are also briefly considered. The second part describes the practical application of these considerations to obtain the best control on typical processes in the British Sugar Corporation's factories. The third part is a practical example of how control engineering theory can help to throw light on the process itself—pulp drying—and lead to improvements in plant design.

* * *

Optimum campaign length. S. ZAGRODZKI. *Gaz. Cukr.*, 1960, **62**, 104–111.—The question of optimum campaign length in Poland is treated mathematically with numerous equations and graphs based on the beet sugar content, the amount of sugar produced and costs of sugar production. From the point of view of costs, the optimum lies between 66 and 70 days.

* * *

The "Kristalloskop" instrument for sugar boiling. Z. WLASSICS. *Cukoripar*, 1960, **13**, 110–113.—Full details with diagrams are given of the "Kristalloskop" pan boiling instrument. An optical instrument, it permits crystal images to be projected by a series of lenses and mirrors onto a screen at ×30 enlargement.

[1] *I.S.J.*, 1959, **61**, 376.

Sugar factory waste-water economy. S. KOTACZOWSKI and H. BIERWAGEN. *Gaz. Cukr.*, 1960, **62**, 131–141.—Numerous data on waste-water are tabulated for a number of Polish factories. The amounts of condenser, flume and diffusion waste water varies from 8350 to 8450 cu.m./1000 tons of beet, 5780–12,130 and 1750–2700 cu.m./1000 tons respectively. The average BOD_5 is 187 mg O_2/litre for condenser waste water, 160 mg for flume water, and 4000 mg O_2/litre for diffusion waste water. The purification methods are discussed.

* * *

Demineralization of sugar juices by means of electrodialysis. M. LESZKO. *Gaz. Cukr.*, 1960, **62**, 141–142.—Electrodialysis treatment of sugar juices is discussed with reference to the ion exchange membranes produced by various firms and their conductivities.

* * *

New forced-flow evaporator. T. NYÁRY. *Cukoripar*, 1960, **13**, 141–142.—Details are given of structural alterations made to the heating chamber and downtake of a Robert evaporator to increase its capacity. As a result of the modifications the specific evaporation was 32·6 kg/sq.m. compared with 24·4 kg/sq.m. for a normal Robert evaporator, and the heat transfer coefficient was 2234·7 kcal/sq.m.1°C compared with 1671·8 kcal/sq.m. 1°C. The actual heat transfer constituted 92% of the theoretical, compared with 82·6% in the case of the normal Robert evaporator.

* * *

J-diffusion at Sarkad sugar factory. ANON. *Cukoripar*, 1960, **13**, 143–147.—Performance data are given for the J-diffuser with press water return at Sarkad factory during 1959/60 (121 days' campaign) and data from the Robert battery diffuser presented for comparison. Juice purity in both diffusers was almost identical (86·4 in the J, 86·3 in the battery). Losses in the J were 0·29% at 122·6% draught, compared with 0·49% at 118·1% draught in the battery. Further data on the juice are also supplied: 0·68 g invert sugar/100° Bx, 5·64 g colloid content/100° Bx, $5{\cdot}0 \times 10^5$ mesophiles per ml, and 3652 thermophiles per ml for the J diffuser, compared with corresponding values of 0·66, 5·61, $12{\cdot}1 \times 10^5$ and 3499.

* * *

Counter-flow, hot predefecation. K. VUKOV. *Cukoripar*, 1960, **13**, 152–157.—The advantages of hot counter-flow pre-liming over the cold process are discussed with 15 references to the literature. Pilot-plant tests have demonstrated the fact that the filtration rate of 1st carbonatation juice is considerably higher and the settling rate also higher, to a lesser extent, when the juice is pre-limed at 85°C. Unless the progressive pre-liming is comparatively quick and regular, at low invert content the juice will be darker than cold-limed juice, and lighter at high invert contents. This is explained by VAŠÁTKO's findings[1] on the colouring of juices caused by the decomposition of invert sugar at low alkalinities.

Microbiological control in sugar factories in 1959/60. Z. I. TÓTH. *Cukoripar*, 1960, **13**, 186–191.—Numerous details are given of the microbiological control measures, with graphs demonstrating the changes In pH with temperature throughout the cells of a battery diffuser, where formalin or sodium hypochlorite are added. The bacteria in other sections of a factory have been investigated and methods of combating infection are enumerated.

* * *

Industrial application of progressive defeco-saturation (the Schneider-BMA process). L. SLAVIČ. *Cukoripar*, 1960, **13**, 161–167, 193–197.—The principles of the BMA defeco-saturation process are explained with flow sheets and with illustrations of the equipment used. Performance data are given of the defeco-saturation plant at Crvenka sugar factory, Yugoslavia. Campaign averages of the filtration coefficient F_k, settling rate and mud volume of 1st carbonatation juice were 1·1, 12·1 cm/min, and 14·0% respectively, with a filter mud pol of 1·0. The thin juice lime content was 0·077% CaO/100° Bx and in thick juice—0·092% CaO/100° Bx, a lower lime content than at any of the 7 other Yugoslavian factories with which Crvenka is compared. The colour of the juices was high, but by using after-liming, a juice was obtained which was clear and transparent and heat-stable. The purification effect at 41·2 and 42·2% for thin and thick juices respectively was also higher than at the other factories.

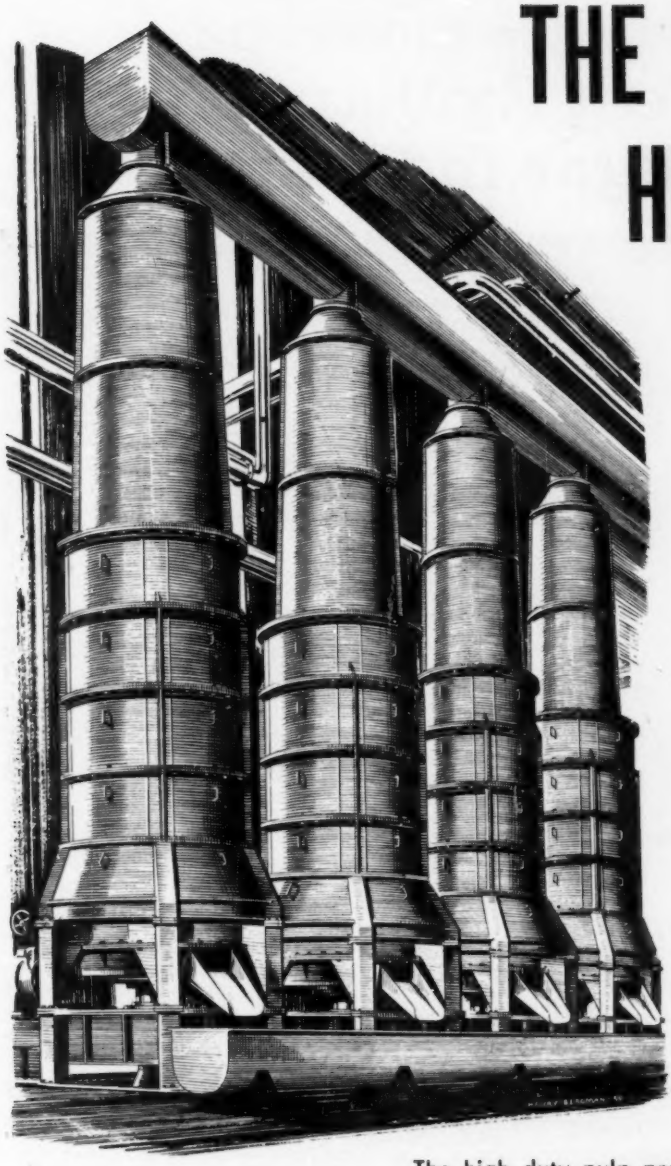
* * *

Progressive counter-flow defecation with return of unfiltered carbonatation juice. R. KOHN, V. TIBENSKÝ and J. VAŠÁTKO. *Listy Cukr.*, 1960, **76**, 121–126.—Equations are derived for calculation of the rise in alkalinity of juice passing down the pre-liming column previously described[2]. The alkalinity rise was calculated for juice without return of carbonatation juice, with addition to raw juice of 100% return unfiltered oversaturated juice of 0·020% CaO alkalinity, and with return of 100% 1st carbonatation juice of 0·080% CaO alkalinity. A graph is presented of the alkalinity rise in each case, the juice being added as normally at the bottom section 7, and of the alkalinity rise when the returned juice is added to other sections. It is shown that the middle column (section 4) is most favourable for addition of returned juice. An equation is also derived expressing the relation between the rotation of the juice in the column and the pre-liming time at a constant ratio of radius: height of column. Experiments conducted on return of $CaCO_3$ or mud particles show that this is most effective when they are added to the raw juice before pre-liming, i.e. before coagulation of the colloids, the mud particles acting as coagulating agents. From this it follows that return of oversaturated juice of 0·020% CaO alkalinity is preferable to return of normal carbonatation juice.

[1] Cistenie repnej st'ávy. (Bratislava, Czechoslovakia.) 1950. pp. 241-252.

[2] *I.S.J.*, 1959, **61**, 373; 1960, **62**, 258.

THE NEW HIGH DUTY PULP PRESS



gives

a great output of pressed pulp with high dry matter content.

Increases

the output of the drying unit and lowers fuel costs.

Result

In several European countries our pulp presses have been redeemed in a very short time.

The high duty pulp presses have been developed jointly by
S S A (Swedish Sugar Co. Ltd.) and **LANDSVERK** (Landsverk Co. Ltd.)

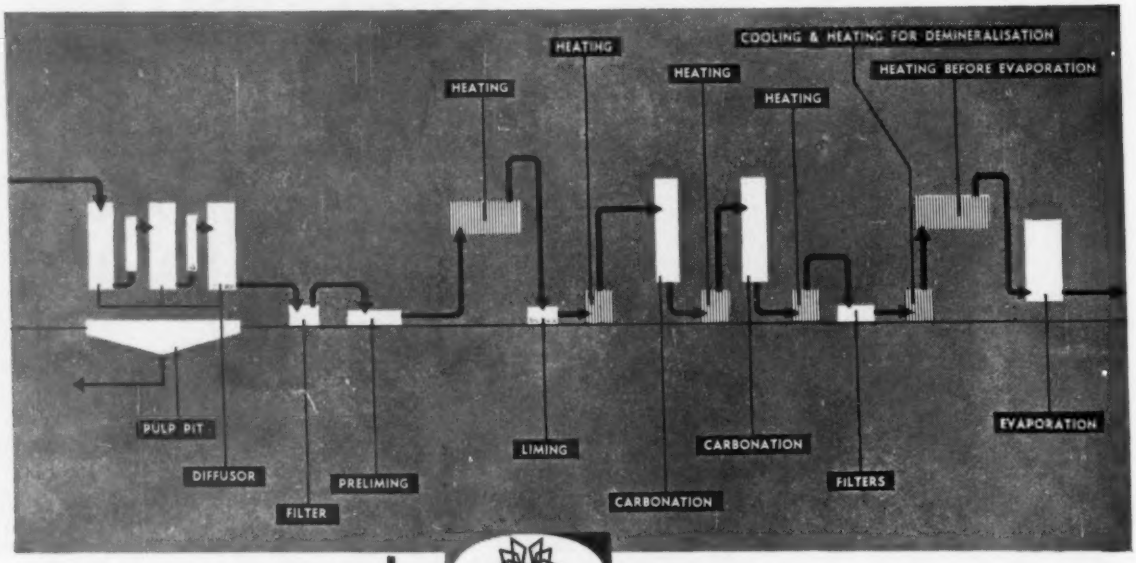
For information please apply to our Sugar Department

British patent nr 803, 216
Other patents applied for.

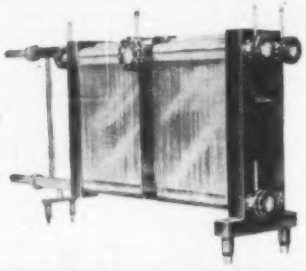
Landsverk
AKTIEBOLAGET LANDSVERK · LANDSKRONA · SWEDEN

DE LAVAL

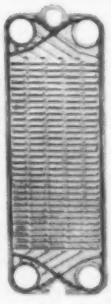
Plate Heat Exchangers in the sugar industry



This simplified flow chart of the beet sugar process shows some of the many stages where heat exchangers are used and where De Laval Heat Exchangers are now being installed in many modern sugar factories.



Above: Complete De Laval Plate Heat Exchanger with two sections, designed for ready accessibility, easy plate removal and automatic alignment.



Right: Single high-grade stainless steel heat transmission plate of the above unit. Special design ensures maximum heat transfer with minimum pressure drop.

Modern agricultural techniques have vastly improved the standard of sugar-beet crops – in some cases doubling the yield per acre and increasing the sugar content by as much as 50 per cent.

Within the beet-sugar industry itself one of the most recent advances comparable to the improvement of beet crops has been the higher sugar extraction obtained by factories adopting ion-exchange juice purification. This development has been based on the heat economies made possible by the use of heat exchangers. Several beet-sugar factories in Europe have recently installed ion-exchange stages and practically all have used De Laval Plate Heat Exchangers exclusively.

De Laval Plate Heat Exchangers have long been in use in sugar manufacturing where their quality, ease of cleaning and excellent heat exchange characteristics have resulted in considerable savings.

ALFA-LAVAL
DE LAVAL

Plate Heat Exchangers for industrial applications

For further particulars please contact your nearest Alfa-Laval/ De Laval Company or agent or write to Alfa-Laval, Stockholm, Sweden.

NEW BOOKS AND BULLETINS

Sugar Cane Nutrition and Culture. H. F. CLEMENTS. 190 pp + xlviii; 6½ × 9¾ in. (Indian Institute of Sugar Cane Research.) 1959.

The importance of this book lies in the fact that it not only describes the system of crop logging for which the author is so well known, but that it also describes the historical reasoning by which he arrived at his conclusions on such matters as the optimum tissues for the determination of the particular factor under study in relation to its growth.

It is noted in the preliminary lecture that though the yields of the variously fertilized plots varied greatly, the plain fact is that the differences in yield of the same treatments from year to year were often larger than among the fertilizer treatments. In other words, climate is the dominant factor and it is natural that the following lecture should deal with moisture relations—the only climatic factor subject, where irrigation is available, to man's control. Here the Hawaiian system of control by use of tensiometers is discussed.

Four lectures follow dealing respectively with potassium, nitrogen, phosphorus and calcium with magnesium and the minor eelments. These use primarily cane yield (T.C.A.) as the yardstick but, from the economic aspect, yield of sugar (T.S.A.) is the more important and this aspect is dealt with in some detail in the seventh lecture. The eighth lecture covers the somewhat irrelevant subject of weed control and the ninth, contracted to two brief paragraphs, sums up the cultural system adopted in different territories. Interest is added by the discussion, in the form of question and answer, which follows the lectures.

The appendices give valuable details of the procedures in selecting and analysing cane samples (34 pp) followed by 12 tables of detailed data of the various determinations—moisture content, N, P, K and so on—for all tissues and at approximately monthly intervals.

The author has performed a notable service in providing a firm basis for further discussion of what has come to be termed, if incorrectly, foliar diagnosis, of which the literature has hitherto been widely scattered; and it is unfortunate that the text is marred by rather numerous typographical errors.

H. M.-L.

* * *

Fertilizers in the Commonwealth, 1950-1958. 44 pp; 6 × 9½ in. (Commonwealth Economic Committee; H.M. Stationery Office.) 1960. Price: 4s 0d.

The progress in the local production and use of fertilizers in the several constituent territories of the Commonwealth is described and the respective figures are tabulated. But the term "fertilizer" is interpreted in the narrow concept of NPK only.

H. M.-L.

Proceedings of the Sixteenth Annual Convention of the Deccan Sugar Technologists' Association (India), 1959. Part I. (two vols.) 180 pp; 6½ × 9½ in. (Deccan Sugar Technologists' Association (India), Ugarkhurd, Dist. Belgaum, Mysore, India.) 1959.

After an index, the 1958/59 office bearers, members of the executive council, co-opted members, technical sub-committees, past presidents, honorary member, patrons, life members and companion members of the Association are listed. Following these are the texts of the papers presented to the Convention, numbering 26 in all.

* * *

Report on the Progress of Applied Chemistry. Vol. XLIV, 1959. 705 pp; 5½ × 8 in. (Society of Chemical Industry, 14 Belgrave Square, London S.W.1.) 1960. Price: 100s 0d (to non-members).

The "Applied Reports" continue[1] with minor changes, the sub-section on "Sugars" again being contributed by Dr. H. M. THOMPSON. Developments recorded in the literature of 1959 are reviewed, the divisions being cane sugar, beet sugar, crystallization and miscellaneous. There are 26 references, as well as a supplementary bibliography classified into "Physics and physical chemistry," "Sucro-chemistry," "Analysis" and "Miscellaneous."

* * *

Report of the Government Chemist, 1958-59. 56 pp; 6 × 8½ in. (H.M. Stationery Office, London E.C.1.) 1960.

The laboratory of the Government Chemist provides a wide variety of analytical, investigatory and advisory services to all U.K. Government departments that request them. It acts as official analyst or referee in cases of disputed analyses and also undertakes various kinds of research, e.g. the development of chemical methods of analysis, study and development of physical methods of analysis, nutritional and physiological surveys, studies of oil pollution, and other special investigations. The current report covers the period April 1st, 1958 to December 31st 1959, and contains reports on some work with a direct bearing on the sugar industry. These included work on the polarization of raw sugar solutions and modification of the specification for basic lead acetate, both being incorporated in reports to the 1958 meeting of ICUMSA in Washington. Work was also done on determining the extent of contamination of rum by a fluosilicate composition used as a wood preservative in the storage vats.

[1] *See I.S.J.* 1960, **62**, 227.

Laboratory Methods and Chemical Reports

Rapid method for mass determination of the marc content in beet. I. HOLLY. *Cukoripar*, 1960, **13**, 69–71.—The total dry solids content of the beet pulp is determined by oven-drying at 105°C; the percentage soluble dry solids content is then determined using a Zeiss "Ultra-thermostat" refractometer. The difference between the soluble and total dry solids is the marc content. Tests on commercial beet varieties from various countries show that 5% is the average marc content.

* * *

The dependence of sugar decomposition rate on temperature above 100°C. G. VAVRINECZ. *Cukoripar*, 1960, **13**, 75–77.—An empirical formula is derived for calculation of the rate of decomposition of sugar, based on the data of HERZFELD[1], STADLER[2] and SPENGLER *et al.*[3], as well as the author's own data for pure sugar solutions and dilute solutions at 75–130°C. The formula takes the form $\ln i = 34 \ln T - 88{\cdot}6$, where i = amount of invert sugar formed in 1 min (mg/100 of sugar), and T = absolute temperature (°K).

* * *

The determination of colour of crystal sugar in solid state. K. JÁNOSFY. *Cukoripar*, 1960, **13**, 133–141.—The Zeiss ball reflectometer, a combination of an Ulbricht sphere and a Pulfrich photometer, has been found particularly suitable for whiteness determination of granulated sugar, fine crystal and sugar seed. The smooth inside surface of the ball, coated with white barite, ensures even reflection. The method involves the use of three filters, giving an unequivocal colour value in terms of the XYZ system of the CIE and of the standard reference triangle. Five careful determinations are required per sample. Hungarian and German test values are compared, the latter agreeing better with the standard values.

* * *

Sucrose solubility. I. G. VAVRINECZ. *Cukoripar*, 1960, **13**, 182–183.—Third degree equations are derived for calculations of sucrose solubility, based on HERTZFELD's and GRUT's data. In the case of HERZFELD's data, the equation takes the form $P = 64{\cdot}763 + 0{\cdot}06174\,t + 0{\cdot}0023866t^2 - 0{\cdot}00001195t^3$, where p = % sugar content by weight and t = temperature in °C. Comparison between calculated values using HERZFELD's second degree formula and actual data shows an average deviation of $\pm 0{\cdot}23$, whereas between the values obtained using the third degree equation and the actual data the average deviation is $\pm 0{\cdot}05$, at temperatures from 5·20°C to 99·45°C. The equation based on GRUT's tables is $p = 63{\cdot}753 + 0{\cdot}13542t + 0{\cdot}0008869t^2 - 0{\cdot}000002222t^3$. Comparison between this and actual measurements gives an average deviation of $\pm 0{\cdot}011$, compared with $\pm 0{\cdot}035$ between actual and GRUT's data. Between HERZFELD's and GRUT's data the average deviation is $\pm 0{\cdot}39$; between the two third-degree formulae it is $\pm 0{\cdot}14$, so that either of the new equations may be used safely for solubility calculations.

* * *

Yellowing and nitrogen content of white sugar. V. PREY, E. STEINBAUER and H. BERBALK. *Zeitsch. Zuckerind.*, 1960, **85**, 300–301.—Yellow coloration of stored white sugar occurred in one Austrian factory some months after the 1959/60 campaign. The sugar was dissolved in water and passed through a column of "Asmit 259" decolorizing resin. This was washed free of sugar and the coloured substances eluted with N/10 HCl. After hydrolysis with 5 N HCl during 18 hr at 105°C and neutralization with ammonia, the solution was studied chromatographically. The solvent used was 4:1:1 butanol:acetic acid:water with ninhydrin as spray reagent. Aspartic and glutamic acids were detected, plus cystine, alanine, aminobutyric acid, valine and leucine. Quantitative determination of the N content of the coloured sugar, of normal white sugar and raffinade was carried out by the Kjeldahl method. The coloured sugar contained twice as much N as the other samples. A 1-kg sample was passed through "Amberlite IR 120" and "Amberlite IRC 50" columns to separate the amino acids, which were then determined by formol titration. The amino acids content of the white sugars and of the coloured sugar was identical with the values given by the Kjeldahl method. The results establish that the coloration was caused by substances of the melanoidin type, formed by the Maillard reaction from invert sugar or still lower degradation products of sucrose on the one hand and amino acids or lower peptides on the other. As a guide to the storage quality of white sugar, the pol, colour, invert content, ash content, pH, free N and total N contents should be determined. Details are given of analytical procedures for free and total N contents. Micro-determination of the total N content is preferable to macro-determination since it is more rapid and results of both techniques agree closely.

* * *

The disappearance of the reducing power during degradation of glucose and fructose in lime-sucrose solution (in presence of nitrogen). P. L. MOTTARD. *Ind. Alim. Agric.*, 1960, **77**, 23–31, 91–97, 169–174, 277–281.—Tests were carried out at alkalinities of 0·1–0·6 equivalent OH/litre with glucose solutions of

[1] *Z. Ver. deut. Zuckerind.*, 1891, **43**, 745–755.
[2] *Archief*, 1931, **39**, III, 689; *I.S.J.*, 1932, **34**, 273.
[3] *Z. Ver. deut. Zuckerind.*, 1936, **86**, 193–239.

approximately 20 millimoles/litre concentration and sucrose solutions of 9·5–47·5% w./v. and over the temperature range 50–90°C. At both high and moderate alkalinities, the rate of degradation in a lime medium was about four times that in a NaOH medium. For given conditions of temperature, alkalinity and sucrose concentration, the constant k_1' as a function of the time of degradation of glucose is constant, i.e. the reaction is of the 1st order with respect to glucose except at the start of the reaction and above 80% loss of reducing power. The value of k_1' increases linearly with increasing alkalinity, making the reaction a 1st order reaction with respect to the alkalinity. A higher temperature increases k_1' a rise of 10°C trebling the rate of degradation at constant alkalinity and sucrose content. A decrease in the sucrose content increases the degradation rate, a drop from 14·25% to 9·5% increasing the rate by 20% at constant alkalinity and temperature. This is attributed to the functioning of the sucrose as an acid, resulting in a drop in the alkalinity of the mixture. Tests were conducted on fructose of 20 millimoles/litre concentration at 0·1–0·3 equivalent OH/litre, 50–80°C and sucrose concentrations of 9·5–19%. Starting with glucose, the fructose that is formed is more rapidly degraded than glucose, the order of the reaction remaining unity; on the other hand, starting with fructose, interconversion to glucose is more rapid, and this is degraded less rapidly than the fructose, so that the glucose concentration builds up during the reaction. Consequently, the value of k_1 is initally very high, then decreases progressively as the reaction becomes more and more a glucose degradation. The effects of changes in alkalinity, temperature and sucrose concentration are as for the glucose, although the degradation rates are higher in the case of the fructose. The degradation of invert sugar is closer to a glucose degradation than a fructose degradation, and after the initial stationary stage is equivalent to 70% glucose and 30% fructose. Nomograms are presented for invert sugar degradation times at sucrose concentrations of 19% w./v. for temperatures of 50°C and 70–80°C.

* * *

A comparison of two methods of sugar distribution (for cane payment) in the Philippines. C. B. RAYMOND. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 245–251.—The methods of sugar distribution compared are that based on a fixed molasses gravity purity of 39, and that based on a sliding scale of molasses gravity purity. A table of values calculated with the former method can be set out simply in 1 day, its chief defect being the assumption that all cane delivered to the mill will give final molasses of identical gravity purity regardless of the quality of the first expressed juices. Thus no penalty is imposed for low purity cane. The disadvantage of the other system lies in the heavy penalties imposed for low purity first expressed juices when a very high gravity purity of molasses is assumed.

The importance of pol Java ratio in the chemical control of cane sugar factories. V. G. PARANPAN. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 282–293.—See *I.S.J.*, 1959, **61**, 378.

* * *

Colorimetric method for the submicro estimation of sugars. S. BOSE, S. MUKHERJEE and A. N. SHRIVASTAVA. *Sharkara*, 1960, **3**, 7–11.—Tests carried out with thymol and phenol, both in sulphuric acid, as reagents for colorimetric determination of sugars are described. Thymol in H_2SO_4 gave a violet-black precipitate when the sugar solution was heated, and in glacial acid and concentrated HCl produced colour in the presence of a number of sugars, including kestose, arabinose, xylose, glucose, galactose, mannose and maltose. Attempts to draw a standard curve for glucose at 10–100 micro-grams at its maximum absorption of 510 mμ gave erratic results and were abandoned. Standard curves were drawn for xylose, arabinose, glucose, mannose, galactose, rhamnose, fructose, sucrose and raffinose hydrate, using phenol in H_2SO_4 as reagent, at 470 mμ, and concentration of 5–36 micrograms. The relation between optical density and concentration was linear over the range 5–20 micrograms/ml for glucose, mannose and fructose, while it was linear over the range 5–25 micrograms/ml for the remaining sugars. The optical densities with different filters are tabulated.

* * *

Recent developments in crystallization studies. F. H. C. KELLY. *Sharkara*, 1960, **3**, 12–19.—The literature on sucrose crystallization is reviewed and openings for future research are indicated.

* * *

Deterioration of refined sugars during storage. J. DUBOURG and P. DEVILLERS. *Sucr. Franç.*, 1960, **101**, 163–165.—Tests were carried out on refined sugar stored loose in a shop at 40–50°C and which had deteriorated, with increase in the reducing substances, a drop in pH to 4·3 and strong coloration. Results of the tests show that the deterioration was caused by: storing warm sugar at low pH, leading to an increase in the reducing sugars content; combining the reducing sugars with the amino acids and development of the Maillard reaction with release of heat, formation of colouring substances, formation of carbonic acid and further lowering of pH; rapid production of reducing sugars caused by the pH drop, these sugars remaining unchanged after the disappearance of the amino acids.

* * *

Rapid method of determining the moisture content of sugar and refinery magma. E. B. LYSYANSKII. *Sakhar. Prom.*, 1960, (7), 34–38.—The method is based on the reaction between Ca carbide and water, whereby the acetylene gas formed is a direct measure of the moisture content. For a moisture content of 0·01–0·45% the analysis takes less than 5 min and accuracy is to within ±2–5%.

BY-PRODUCTS

Drying of green fodder, beet leaves and potatoes—an economically important by-product of the sugar industry. E. PÖTKE. *Zuckererzeugung*, 1960, **4**, 151–157, 171–172.—Factory tests carried out at 6 factories. including 3 sugar factories, are discussed from technical and economic aspects and recommendations are offered on the basis of the results.

* * *

Bond and wrapping papers from sugar cane bagasse. M. R. MONSALUD. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 294–308.—Experimental wrapping and bond papers have been produced from depithed and undepithed bagasse. Higher yields and better quality pulp was obtained from the former, lower quantities of pulping chemicals being used with the undepithed bagasse. The depithed fibre amounted to just over 50% of the whole bagasse, the pith about 25%, on oven-dry basis.

* * *

A report on pilot plant studies on rum technology at Puerto Rico. V. RODRÍGUEZ BENÍTEZ *et al. Sugar J.* (La.), 1960, **23**, (1), 34–47.—A pilot plant has been established as a division of the Agricultural Experiment Station of the University of Puerto Rico for studies in production of rum, alcohol and allied products. It has a capacity of 600 gal of distilled rum spirits per day and includes six 500-gal fermenters and a 3-column distillation unit. A rum warehouse is being constructed for ageing experiments. Details are given of the research programme and a list is presented of works on rum technology and allied subjects written by the technical staff of the pilot plant.

* * *

Catalytic hydrogenation of sugars. C. BOELHOUWER, D. KORF and H. I. WATERMAN. *J. Appl. Chem.*, 1960, **10**, 292–296.—In a series of comparative hydrogenation experiments using sucrose as raw material, it is shown that high yields (up to 75%) of distillable polyalcohols (mainly glycerol and 1,2-propanediol) are obtainable at moderate temperatures (200–250°C) with copper chromite catalysts activated with beryllium oxide. Nickel catalysts are active at even lower temperatures, particularly in the presence of $Ca(OH)_2$; thus 70% of distillable polyalcohols were obtained by hydrogenating sucrose in methanol in the presence of 3·5% $Ca(OH)_2$ (by weight) and 15% of a nickel-on-kieselguhr catalyst during 105 min at 195°C. The Weber method of product distribution analysis permits easy comparison of the experimental results, especially regarding selectivity of the applied catalysts.

* * *

Improved pig rations. G. E. COMBS, C. E. HAINES and H. D. WALLACE. *Sugar Molecule*, 1960, **11**, (2), 18–20.—Feeding of 14-day old pigs with rations containing 10–40% C-sugar during 42 days resulted in substantial increases in feed consumption. The pigs showed marked preference for the 30 and 40% feeds and weighed an average of 15·7 lb more when 56 days old than the control pigs.

* * *

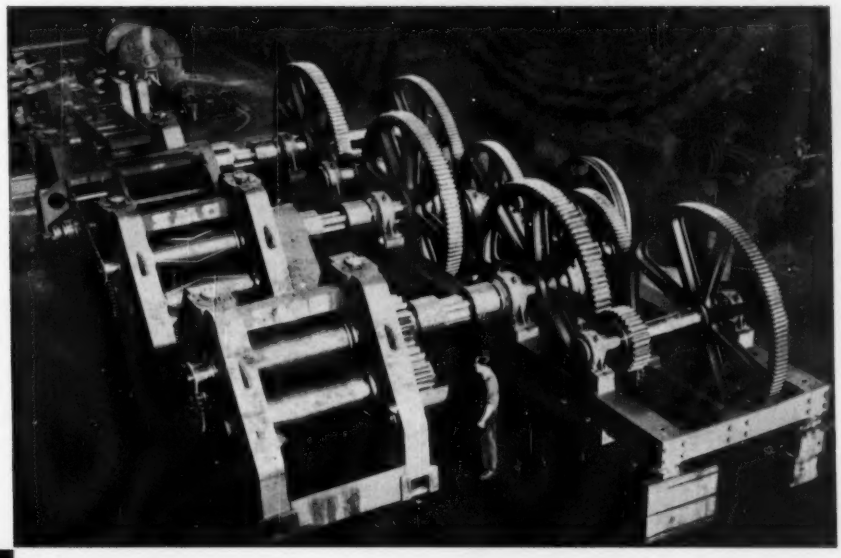
Sugar beet leaves in the fodder industry and its improvement. H. J. RÖSTEL and W. WÖHLERT. *Zuckererzeugung*, 1960, **4**, 247–249.—The importance of beet leaves in fodder production is discussed. Recommendations on the recovery of the leaves, evaluation and storage are offered, and tests described in which a high correlation was found between the raw albumin content of the leaves and digestible albumin. Tests were conducted on Kleinwanzlebener beet varieties with regard to leaf spread.

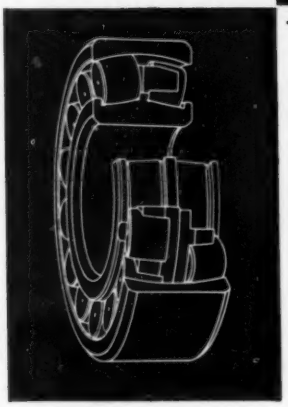
* * *

Studies on sugar cane bagasse. I. Proximate analysis of bagasse and the fractions derived therefrom. S. R. PATHAK and V. R. SRINIVASAN. *Indian Pulp & Paper*, 1958, **12**, 429–431; through *S.I.A.*, 1960, **22**, Abs. 695.—Bagasse (from Co 419 cane) was separated into fibre and pith fractions, and the original bagasse and each fraction were pulverized separately. The powders were extracted with 1:2 alcohol-benzene mixture (6 hr) and then with water at 23°C (24 hr) and at 55°C (exhaustively). The amounts of soluble matter extracted in each case, and the approximate analyses (ash, free sugars, cellulose fractions, lignin, pentosans and uronic acids) in the dry residues after alcohol-benzene extractions are tabulated. The fibre and pith do not differ greatly in composition.

* * *

Pulp and paper from sugar cane bagasse. Y. A. FAHMY and E. EL ASHMAWY. *Indian Pulp & Paper*, 1959, **14**, 161–167; thorugh *S.I.A.*, 1960, **22**, Abs. 697.—Pulping tests have been made on bagasse freed from dirt and dust (including loose pith cells) by sieving, using whole bagasse or bagasse which had been depithed by the dry or wet process. For both the unbleached and bleached pulps, dry depithing had practically no influence on the chemical and mechanical characteristics. It seems that dirt, and dust, and not the pith itself, are responsible for reduction of pulp strength characteristics. There were also no clear differences from results with whole bagasse, when wet depithing was carried out after alkali treatment (first stage in the two-stage process). Short time ($\gtrsim$ 1 hr) soda and Kraft pulping at relatively high temperatures gave the better pulps. Two-stage alkali treatment enabled the easier, wet-depithing to be carried out. Bleaching had little effect. The removal of increasing amounts of fine and short fibres from kraft pulps causes a notable increase in α-cellulose content and a reduction of ash content; tear resistance, and fold endurance increased enormously, and tensile strength was somewhat less. The methods of treatment and of analysis are described, and results are fully tabulated.





Sugar cane rolling mills and drives equipped with SKF spherical roller bearings. Manufacturers: SMG Salzgitter, Germany.

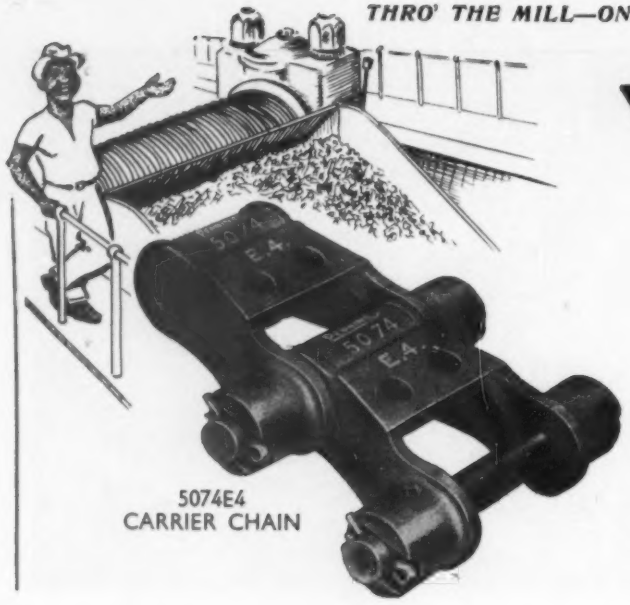
SPECIFY SKF ROLLER BEARINGS for new rolling mill equipment

SUBSTITUTE SKF ROLLER BEARINGS for the plain bearings of existing equipment

SKF roller bearings increase reliability, simplify lubrication and maintenance, and offer improved cleanliness.

SKF

THRO' THE MILL—ON PENNINE CHAIN



5074E4
CARRIER CHAIN

well-fed rollers

Intermediate carriers feeding cane fibre between mill rollers have to withstand severe wear during grinding seasons, and Pennine 5074E4 Chains, for double-sprocket use, are highly recommended for this service.

Heavy outside driving lugs give longer wear. The twin attachment holes are equidistant from pins for slat assembly with laps leading or trailing.

Other roller and pintle chains suitable for intermediate carrier work can also be supplied.

Sugar production runs smoother on

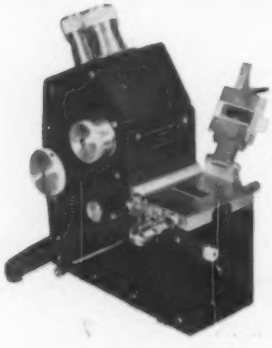
TOUGH MALLEABLE IRON—LONG WEARING
INTERCHANGEABLE WITH OTHER MAKES

Pennine chain

Catalogues on request: PENNINE CHAINBELT CO. LTD., ARMLEY, LEEDS 12, ENGLAND

PRECISION BS INSTRUMENTS

The New
ABBE 60 REFRACTOMETER



HORIZONTAL
FIXED PRISM

SMOOTH CLEAN
LINES

TOTALLY ENCLOSED
GLASS ARC

BACK ILLUMINATION
TO THE PRISM

Bellingham & Stanley Ltd
DEPT. I, 71 HORNSEY RISE, LONDON, N.19
PHONE: ARCHWAY 2270

CARY SUGAR CANE
HARVESTER–CLEANER–LOADER

The Cary combination Harvester-Cleaner-Loader harvesting extremely recumbent 70 ton per acre cane and loading short lengths (15 in. or 22 in. lengths) into special side dump trailers. Capacity under Florida conditions 250-300 tons per day (cut, cleaned and loaded).

Manufactured by
CARY IRON WORKS
OPELOUSAS, LOUISIANA
(Also manufacturers of 3 to 12 ton Carts and Trailers and 4 to 8 ton Field Derricks and Hoists)

Export Division
LOGAN PERKINS—SUGAR MACHINERY
International Trade Mart, New Orleans, U.S.A.

PATENTS

UNITED STATES

Lubricants containing fatty acid esters of saccharides. A. J. MORWAY and W. E. WADDEY, assrs. ESSO RESEARCH & ENGINEERING CORP. **2,944,024.** 28th March 1958; 5th July 1960.—See U.K.P. 840,368.[1]

* * *

Rapid soda process for pulping bagasse. S. B. KNAPP and J. D. WETHERN, assrs. HAWAIIAN DEVELOPMENT COMPANY, of Honolulu, Hawaii, U.S.A. **2,944,929.** 5th January 1959; 12th July 1960.—Whole bagasse is digested with 6–16% (9–16%) by weight of an active soda pulping agent predominantly NaOH, forming a mixture with a liquor: dry bagasse ratio of 2:1–15:1 (2:1–6:1; 4:1–10:1), heating under pressure at 130–210°C (150–190°C) over a period up to 45 minutes (1 sec–15 min) and maintaining at that temperature for 1–25 min (2–15 min). Pressure is reduced over a period up to 15 minutes, yielding a pulp having a pentosan content of 20–30% by weight.

* * *

Certain oxyalkylated sucroses and method of making same. M. DE GROOTE and O. H. PETTINGILL, assrs. PETROLITE CORPORATION, of Wilmington, Del., U.S.A. **2,945,023.** 10th April 1957: 12th July 1960.—Oxyalkylated sucroses are prepared by condensation of sucrose with mixtures of ethylene oxide (2-39·5% total weight of product), butylene oxide and propylene oxide at defined proportions in the presence of alkaline catalysts, so as to yield wetting, detergent, levelling and flotation agents.

* * *

Producing butanol by fermentation. M. HONGO, assr. SAURAKU SHUZO K.K., of Tokyo, Japan. **2,945,786.** 15th October 1959; 19th July 1960.—A mash containing carbohydrate, e.g. as blackstrap molasses, (equivalent to 4–60 g sugar per litre), together with nutrient materials, is inoculated with *Clostridium saccharoperbutylacetonicum* and fermented at 25–35°C for 2–5 days, adding alkali from time to time to maintain the pH at 5·5–8·0, thereby producing solvents rich in butanol; after this the mash is fractionally distilled to recover the butanol and acetone.

* * *

Beet harvester clod crusher. J. R. ORELIND and E. M. CLARK, assrs. INTERNATIONAL HARVESTER CO., of Chicago, Ill., U.S.A. **2,947,366.** 14th May 1958; 2nd August 1960.

* * *

Molasses feed. N. F. KRUSE, assr. CENTRAL SOYA CO. INC., of Fort Wayne, Ind., U.S.A. **2,947,632.** 12th January 1956; 2nd August 1960.—Molasses (10–40%; 10–20% by weight) is mixed with a feed meal (toasted desolventized extracted soybean meal) and the mixture dried to a moisture content (8–11%) at which it is free-flowing. Further ingredients may be added, and steam is applied to the mixture to wet the exposed dried molasses surfaces; the material is then pressed into pellets.

* * *

Method for handling sugar (in bulk). J. CORRIGAN, assr. J. C. CORRIGAN CO. INC., of Dorchester, Mass., U.S.A. **2,948,424.** 14th October 1954; 9th August 1960.—Bulk material (sugar) being handled by the system described previously[2] may go to store or to process. When it is not required for process the conveying process may be reversed so that sugar is withdrawn from the bottom of the store and recycled, any lumps encountered being mechanically disintegrated. All the conveying is without substantial pressure on the sugar particles, and the technique prevents and eliminates caking during storage.

* * *

Purification of sugar esters. T. C. M. DAVIS, of Oakland, Calif., U.S.A. **2,948,716.** 12th April 1956; 9th August 1960.—A sucrose monoester of a fatty acid is separated from sucrose by adding sufficient water to dissolve the sucrose, evaporating to a stiff gel and then treating with a (hot) solvent (e.g. a lower aliphatic alcohol, methyl ethyl ketone, methyl *iso*-butyl ketone, an ester such as *iso*-propyl acetate, etc.) which is a good solvent for the ester but a non-solvent for the sucrose. The solvent may be such as to precipitate the sucrose from solution; it is separated and the solvent cooled to crystallize the monoester.

* * *

Sugar ester preparation and purification. V. K. BABAYAN and A. K. ATIKIAN, assrs. E. F. DREW & CO. INC., of New York, N.Y., U.S.A. **2,948,717.** 14th January 1959; 9th August 1960.—Sucrose, in alkaline solution, is agitated turbulently while slowly adding an organic acid chloride ($\frac{1}{3}$ to 3 moles per mole of sucrose) (substantially free from phosphorus compounds) and maintaining the alkalinity (at pH 7–11, 9–10) and the temperature below 65°C (below 20°C; 25–45°C) and so obtaining a crude ester. This is washed with a solution of a salt which does not change the alkalinity of the mixture and causes separation of ester and soap from the aqueous electrolyte-sugar solution. The "salted out" soap-ester layer is removed, dried, the ester extracted with a volatile ketone solvent, (the solution filtered) and the ester recovered (by distillation).

* * *

Beet harvester cleaning and conveying unit. S. F. SOUCIE and A. J. BAUER, of Longmont, Colo., U.S.A. **2,949,160.** 18th December 1958; 16th August 1960.

[1] *I.S.J.*, 1960, **62**, 264.
[2] U.S.P. 2,856,083; *I.S.J.*, 1959, **61**, 123.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Mark 6 portable "Deminrolit" unit. Permutit Co. Ltd., Gunnersbury Avenue, London W.4.

This new unit can convert up to 12 gallons per hour of clean cold water into demineralized water having a conductivity of less than 1·0 reciprocal

megohm/cm, the conductivity being continuously monitored by the meter fitted. It uses a mixed bed of "Zeo-Karb 225" and "De-Acidite FF" resins.

* * *

High-pressure flow indicators and alarms. Brooks Instrument Company Inc., Hatfield, Pa., U.S.A.

Bulletin 132 describes flow ratemeters designed to operate at pressures of up to 1500 p.s.i.g. They are available in ¼, 1 and 1½-in sizes to handle flows of 1½–50 g.p.m.

* * *

PUBLICATIONS RECEIVED

SUGAR CANE MILLING PLANTS. Salzgitter Maschinen A.G., Salzgitter-Bad, Germany.

In a new, very attractive colour brochure, are described and illustrated cane mills and ancilliary equipment produced by Salzgitter. A table of capacities is provided, allowing for the number of mills in a tandem and the size of the mills which vary between 14 × 22 inches and 45 × 90 inches. Photographs show mills with roller and slide bearings, cane knives, vibrating screens, a quick-lift intermediate carrier, transmission gearing, universal joint coupling, and closed-circuit television for mill control, while diagrams are presented of cane washing plant and trash-plate construction, and nomograms allow determination of cane mill and cane cutter power requirements. An example of the calculation of mill extraction is worked, and a list of the equipment made by Salzgitter for the sugar factory is given.

* * *

EIN BLICK IN UNSERE ARBEIT. Buttner-Werke A.G., Krefeld-Uerdingen, Germany.

This 16-page booklet gives a glimpse, as the title suggests, into various aspects of the Buttner-Werke plant and activities. It gives information on the production of drying and dust-separation plant and contains illustrations of the machinery installed as part of a modernization programme. Some details are given of the export orders fulfilled, and mention is made of the apprentice school.

* * *

SILOS FOR WHITE SUGAR—TYPE D.d.S. A/S. De danske Sukkerfabrikker, Copenhagen.

In the autumn of 1954, the Danish Sugar Corporation completed a silo comprising two bins holding a total of 17,000 tons of white sugar. This was at that time the largest built and featured a pre-stressed concrete construction which has since been applied to five more silos in Denmark. A new leaflet describes and illustrates the silos and particular features, while the advantages of changing to bulk storage are discussed and, in particular, the reasons for preferring the D.d.S. type of silo are tabulated.

* * *

LINK-BELT PARALLEL SHAFT SPEED REDUCERS. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new 36-page book, No. 2719, describes Link-Belt's completely redesigned and expanded line of "balanced-design" parallel shaft speed reducers in 57 sizes, including 23 new sizes. Single, double and triple reduction units are available in capacities up to 2800 h.p. at high or low output speeds and ratios up to 292:1. The new book describes the complete line and includes full information for selecting the correct drive, rating tables containing thermal and mechanical h.p. ratings, load classes, overhung loads, extended shafts and outboard bearings, dimensions, etc.

* * *

PNEUMATIC TEMPERATURE TESTING SYSTEM. Cambridge Instrument Co. Ltd., 13 Grosvenor Place, London S.W.1.

A new leaflet, List 331/3, describes the Cambridge pneumatic temperature measuring system designed to provide "non-electric" indication and recording at considerable distances from the point of measurement, taking advantage of existing or extendable air lines. Indicators and recorders are available for any standard temperature range between —100° to +600°C or —100° to +1000°F.

* * *

Farrel cane mill for Argentina.—Farrel-Birmingham Co. Inc. have secured an order for a large cane grinding tandem which will form part of the modernization programme of Ingenio y Refinería San Martín del Tabacal S.A. of Salta, Argentina. The new mill will be of 6000 metric tons daily capacity and each unit will have individual turbine drive, the 1000 h.p. 5000 r.p.m. General Electric turbines transmitting power through totally enclosed Farrel gear drives connected by Wichita air clutches. Centrifugals will also be supplied under the order by Western States Machine Co. The order has been made possible by the Export-Import Bank of Washington, D.C. which has supplied most of the long-term financing required.

EUROPEAN BEET SUGAR PRODUCTION ESTIMATES[1]

(Metric tons—raw value)

	1960/61	1959/60	1958/59	1938/39
Germany, West	1,810,000	1,419,471	1,916,257	2,111,431*
,, East	900,000	633,105	933,000	
Danzig	—	—	—	12,970
Austria	255,000	302,339	296,251	—
Czechoslovakia	1,025,000	733,000	946,000	479,261†
Hungary	413,000	391,900	299,200	127,555
France	2,200,000	1,077,812	1,600,000	828,913
Belgium	475,000	218,843	465,442	193,521
Holland	620,000	510,890	583,849	212,579
Denmark	308,000	252,000	400,000	190,957
Sweden	306,000	284,800	268,900	292,380
Poland	1,275,000	995,000	1,216,700	545,831
Italy	950,000	1,390,000	1,140,844	398,176
Spain	594,000	528,028	447,432	131,318
Slovakia	—	—	—	51,213
Yugoslavia	290,000	274,051	187,374	85,817
Roumania	360,000	285,000	186,436	155,446
Albania	14,000	13,500	13,000	—
Bulgaria	180,000	165,000	130,200	21,782
Switzerland	36,600	42,574	37,164	13,000
Great Britain	850,000	872,960	815,665	326,249
Eire	128,000	141,977	113,546	59,831
Finland	58,000	47,718	39,016	15,014
Latvia	—	—	—	37,040
Lithuania	—	—	—	23,080
Turkey	660,000	543,260	388,248	47,251
Europe excluding U.S.S.R.	13,707,600	11,123,228	12,424,524	6,360,615
U.S.S.R.	7,100,000	6,100,000	6,333,000	2,300,000
Europe including U.S.S.R.	20,807,600	17,223,228	18,757,524	8,660,615

[1] F. O. LICHT, *International Sugar Report*, 1960, **92**, (Supp. 18), 214.

* Includes Sudeten districts and Austria. † 1938/39—Bohemia and Moravia.

BREVITIES

Nationalization of Cuban sugar companies.—It is reported in the press that the Cuban Government on October 13th nationalized, among other property, 105 Cuban-owned sugar mills. The bulk of the sugar industry is now nationalized since, it will be remembered, the 36 American-owned sugar mills were, in effect, confiscated last August.

* * *

Cuban–U.S.S.R. sugar deal rumours. According to reports in the Government-controlled newspaper "El Mundo", quoted by F. O. LICHT, K.G.[1], the Soviet Union has consented to buy all of Cuba's sugar production formerly sold to the United States. This would be an additional quantity of about 3 million tons. C. Czarnikow Ltd. commented[2] on press reports that Cuba was shortly to endeavour to sell her entire crop to Russia for some years to come. While pointing out that, even if there were any truth in the reports, no official intimation could be expected until after the visit of Major GUEVARA, President of the Cuban National Bank, to Moscow, Czarnikow speculates as to its likelihood and significance if it were true. "With a domestic crop expected to outturn at one million tons higher than last season's production, Russia could hardly be expected to absorb such a vast tonnage of sugar into her domestic consumption. On the other hand, if it were intended that ownership would merely pass at the point of production with marketing arrangements continuing as at present it is difficult to visualize any advantage accruing to either party, even though some sort of barter arrangement might be involved, although of course political considerations might be sufficient to outweigh economics". "Nervousness that it (such a tonnage of Cubans) might reappear on the market as Russian whites has not been lessened by a rumour that 150,000 tons of the latter has been on offer in London".

Puerto Rican sugar crop, 1960.[3]—The Puerto Rican sugar harvest which ended in August resulted in a total output of 1,006,385 short tons of sugar (90 pol value) produced by the 29 sugar factories from 10,000,728 tons of cane. Production fell about 300,000 tons short of Puerto Rico's quota for shipment to the U.S.A. and local consumption, totalling 1,323,111 tons. Sugar yield of 10·00% was stated to be the lowest in the last five years, and bad weather conditions during harvesting were mainly to blame for this result. In view of the favourable price prospects for the coming year in the U.S. market, the industry expects to cover its quota for shipment to the United States next year.

* * *

Jaggery production in Northern Rhodesia.[4]—The sugar plant at Kalichero is now producing 200–300 pounds of jaggery sugar per day and it is estimated that a total of about 12 tons will be produced this season. The product is finding an excellent local African market at 4d–5d per lb.

* * *

Indian sugar for export.[5]—A Government announcement from New Delhi stated recently that 50,000 tons of sugar was released for export through the Indian Sugar Mills Association. The Government also said that it was interested in supplying to the U.S. market and that negotiations on this subject were still in progress.

[1] *International Sugar Report*, 1960, **92**, (Supp. 18), 227.
[2] *Sugar Review*, 1960, (477), 171–2; (478), 175.
[3] *Public Ledger*, 10th September 1960.
[4] *Overseas Review* (Barclays D.C.O.), September 1960, p.30.
[5] *Public Ledger*, 24th September 1960.

BREVITIES

Mourilyan terminal in operation.[1]—Although the first shipment from Mourilyan was not expected to take place before October 1960 steady supplies from the district mills were being delivered two months earlier. The new terminal is designed to receive 1700 tons of sugar a day and has a storage capacity of 150,000 tons. The harbour entrance is expected to be completed in February or March 1961 but may be ready earlier; in the meantime smaller coastal vessels will be used to remove sugar but eventually vessels drawing up to 30 ft will be able to berth at the terminal. In the 1959 season 79% of Queensland's sugar was shipped in bulk compared with 72% in the previous season. However, overseas requirements of bagged sugar are not expected to fall below 160,000 tons for some years.

Indonesia Sugar Exports, 1957/59*

Destination	1957	1958	1959
Burma	2,641	0	4,064
Ceylon	20,996	9,094	0
China (Mainland)	19,303	40,638	0
Hong Kong	18,329	20,328	2,337
Iran	0	0	9,336
Japan	10,976	0	1,326
Korea (South)	12,333	4,400	10,342
Malaya and Singapore	22,308	6,706	8,681
New Zealand	4,064	0	0
Pakistan	7,137	0	0
Syria and Lebanon	11,416	0	0
Vietnam, Cambodia and Laos	13,361	6,000	2,965
Total	142,864	87,166	39,051

* *Lamborn*, 1960, **38**, 194.

Stock Exchange Quotations

	CLOSING MIDDLE
London Stocks (*at 17th October*, 1960)	
Anglo-Ceylon (5s)	16/–
Antigua Sugar Factory (£1)	15/3
Booker Bros. (10s)	31/–
British Sugar Corp. Ltd. (£1)	25/3
Caroni Ord. (2s)	4/3
Caroni 6% Cum. Pref. (£1)	17/–
Distillers Co. Ltd. (10s units)	43/7½
Gledhow Chaka's Kraal (£1)	45/–
Hulett & Sons (£1)	50/–
Jamaica Sugar Estates Ltd. (5s units)	4/3
Leach's Argentine (10s units)	27/–
Reynolds Bros. (£1)	36/3
St. Kitts (London) Ltd. (£1)	19/–
Ste. Madeleine (Ord.) (£1)	31/3
Sena Sugar Estates Ltd. (10s)	15/3
Tate & Lyle Ltd. (£1)	56/3
Tate & Lyle Investments Ltd. (5s)	11/7½
Trinidad Sugar (5s stock units)	36/–
United Molasses (10s stock units)	37/9
West Indies Sugar Co. Ltd. (£1)	18/9
	CLOSING MIDDLE
New York Stocks (*at 15th October*, 1960)	**$**
American Crystal ($10)	37
Amer. Sugar Ref. Co. ($100)	29¼
Central Aguirre ($5)	21¼
Cuban American ($10)	14
Great Western Sugar Co.	29
South P.R. Sugar Co.	14½
United Fruit Co.	16⅞

New sugar refinery for Kenya[2].—A new sugar refinery is to be erected at Miwani, to begin operations in 1961. An alcohol distillery is to be connected to the factory, the combined cost being £700,000.

* * *

Bolivian sugar expansion[3].—Sugar production in Bolivia in 1959 reached 19,288 short tons, while the 1960 production is estimated at 30,000 tons. These figures compare with an annual consumption of about 60,000 tons.

* * *

Mauritius sugar crop[4].—All 23 of the sugar factories of Mauritius were working by end-August. Cane and sugar yields continue to be below expectation and the estimates of total sugar production have been revised to 260,000 metric tons. This compares with the 1959/60 crop of 580,372 metric tons. One factory in a region particularly badly affected by the cyclones earlier this year closed on 12th September with a production 85% lower than usual[5].

* * *

Ontario sugar beet industry doubts[6].—The future of Ontario's sugar beet industry is in considerable doubt, it is reported, since it is finding it almost impossible to compete with cane sugar imported and refined at Toronto after being shipped through the St. Lawrence Seaway. Canada & Dominion Sugar Co. Ltd. is quoted as saying that its beet operations have lost money for the past seven years. Only increased government support, it is claimed, can save the industry, which is the subject of a current study by the federal and provincial governments.

* * *

U.K. terminal market decimalization[7].—To simplify operations by overseas members, the committee of the United Terminal Sugar Market Association has reviewed the present basis of the London contract and has decided that it would be far more practical for all users to quota in pounds sterling and decimals per ton of 2240 lb instead of in shillings, pence and fractions of a penny per cwt. As and from 1st November 1960 the U.T.S.M.A. prices will be quoted in pounds per ton with 1s 0d per ton fluctuations all expressed in decimal pounds, for example: £29·05 per ton instead of £29 1s per 2240 lb; £29·10 per ton instead of £29 2s. per 2240 lb. In addition to simplifying conversion into other currencies, it is pointed out, this action reduces the minimum fluctuation from 1s 3d to 1s 0d per ton thereby providing a further trading attraction. The London sugar market daily price from 1st November will be published both in shillings and pence per cwt and pounds and decimals thereof per ton of 2240 lb.

* * *

New sugar factories for India[8].—It is reported that three co-operative factories are to be erected in Punjab at Batala in Guardaspur district, Morinda in Ambala district, and Nawanshahr in Jullundur district. The second is expected to go into production in 1962/63 and the last in late 1961/62. State sugar production will be doubled by this increase in capacity. It is also reported that the State Government of Madhya Pradesh will be setting up two sugar factories on a co-operative basis. Five co-operative factories proposed by the State Government of Maharashtra have been sanctioned by the Union Government; they will be built at Bidri and Kala, in Kolnapur district, Takli in Ahmednagar district, and Korhale and Aklui in Poona district. Union Government sanction is awaited for a further six factories. In Gujerat the State Government is to set up a 500-ton factory at Gandevi in Surat district and is awaiting sanction for another factory at Dhota in Saurastra distrhict.

[1] *Australian Sugar J.*, 1960, **50**, (8), 39.
[2] F. O. Licht, *International Sugar Report*, 1960, **92**, (Supp. 17), 211.
[3] F. O. Licht, *International Sugar Report*, 1960, **92**, (Supp. 16), 199.
[4] *Mauritius Sugar News Bull.*, 1960, (106).
[5] *Overseas Review* (Barclays D.C.O.), October 1960, 22.
[6] *Free Press Weekly* (Winnipeg), 17th August 1960.
[7] *Public Ledger*, 8th October 1960.
[8] *Indian Sugar*, 1960, **10**, 198–200.

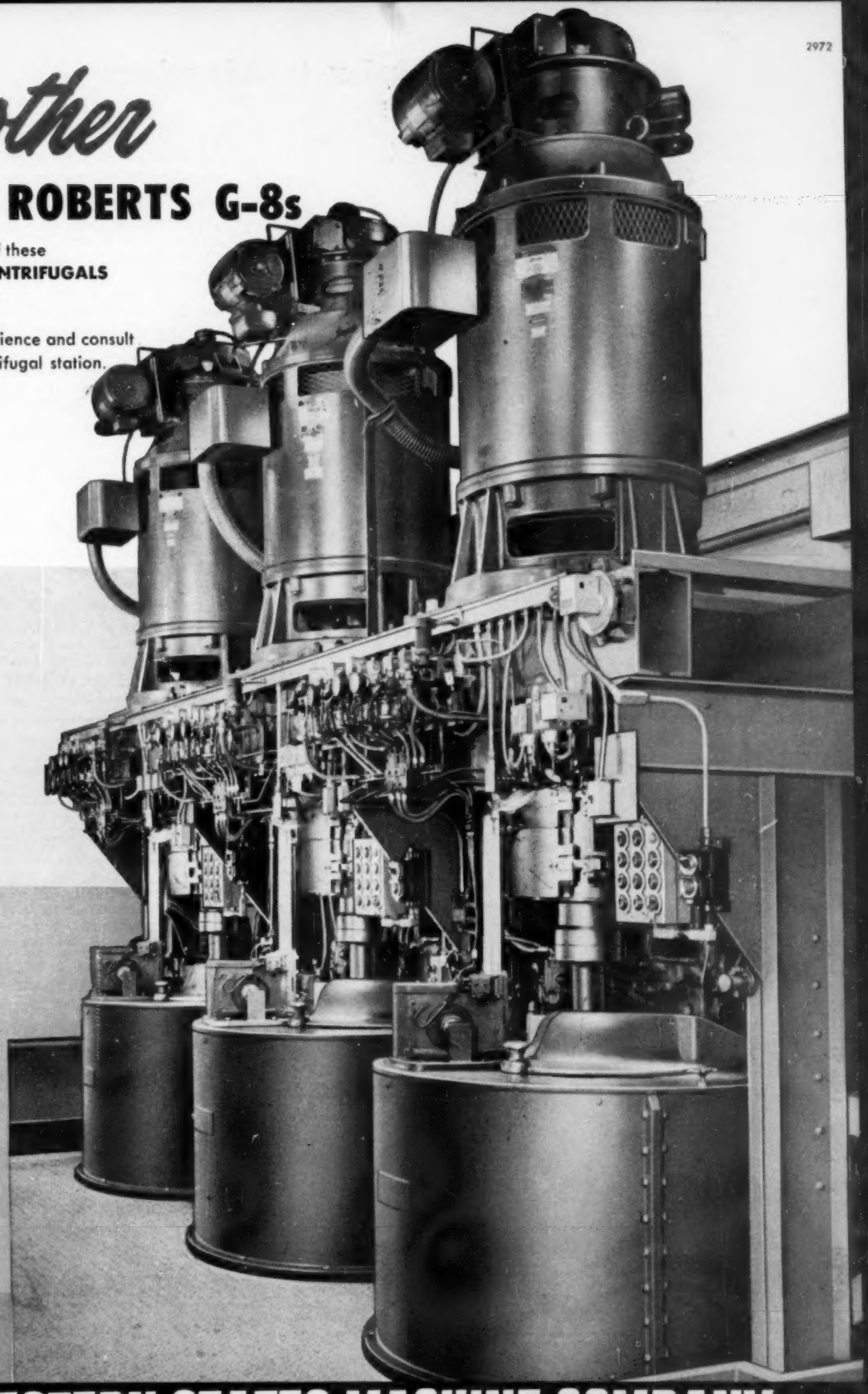
2972

Another

BATTERY OF ROBERTS G-8s

Now there are more than **500** of these
COMPLETELY AUTOMATIC CENTRIFUGALS
in operation throughout the world.

Consider the benefits of this experience and consult us when planning your new centrifugal station.



AMERICAN MOLASSES COMPANY

Chose

these three Roberts 48 x 30 completely automatic, recycling, 1200 R.P.M. G-8 centrifugals for the new Chicago affination station.

THE WESTERN STATES MACHINE COMPANY

HAMILTON, OHIO, U.S.A.

TO KEEP THE LEAD . . . WE THINK AHEAD.

Index to Advertisers

	PAGE
Alfa-Laval	xxxviii
A.P.V. Co. Ltd.	xxxv
Bellingham & Stanley Ltd.	xl
Belliss & Morcom Ltd.	ii
Blairs Ltd.	xxxii–xxxiii
Officine Meccaniche e Fonderie A. Bosco S.p.A.	xi
Thomas Broadbent & Sons Ltd.	i
Broussard Machine Co.	xlvii
David Brown Corporation (Sales) Ltd.	vi
Buttner-Werke A.G.	xxix
Cary Iron Works	xl
Clydesdale Chemical Co Ltd.	xliii
Cocksedge & Co. Ltd.	xxxi
George Cohen, Sons & Co. Ltd.	xliii
A. F. Craig & Co. Ltd.	xvi
Crofts (Engineers) Ltd.	xxvi
Dorr-Oliver Inc.	Inside Back Cover
Dunford & Eliott Process Engineering Ltd.	li
Ewart Chainbelt Co. Ltd.	xlii
Extraction Continue De Smet S.A.	xxx
Farrel-Birmingham Co. Inc.	v
Fisons Pest Control Ltd.	xix
Soc. Fives Lille—Cail	viii
George Fletcher & Co. Ltd.	xxiv, Outside Back Cover
Fontaine & Co.	xlii
Goka N.V.	xlvii
Heenan & Froude Ltd.	ix
Hein, Lehmann & Co. A.G.	xxxiv
N. A. Helmer	xlii
Robert Hudson Ltd.	xliv
Hudson & Wright Ltd.	l
Johns-Manville International Corp.	xxxvi
Kingston Industrial Works Ltd.	xv
A.B. Landsverk	xxxvii
Lepage, Urbain & Cie.	xxviii
E. C. Masson	xlii
Mechans Ltd.	xiv
Mirrlees Watson Co. Ltd.	Inside Front Cover, xii
New Conveyor Co. Ltd.	xiii
Owl Engineering Supplies Ltd.	xliv
Pennine Chainbelt Co. Ltd.	xl
Pott, Cassels & Williamson Ltd.	xxv
Power Plant Co. Ltd.	xlv
Rotameter Mfg. Co. Ltd.	xlvi
Sack Filling & Sewing Machine Syndicate	iv
Salzgitter Maschinen A.G.	iii
Saunders Valve Co. Ltd.	xlvi
Siemen & Hinsch m.b.H.	xlvii
Richard Simon & Sons Ltd.	xlv
S.K.F.	xxxix
A. & W. Smith & Co. Ltd.	xxii, xxiii
Duncan Stewart & Co. Ltd.	xxvii
Stork-Werkspoor N.V. (V.M.F.)	vii
Suchar Sales Corporation	xx
Sugar Manufacturers' Supply Co. Ltd.	xxi
Technoexport, Czechoslovakia	x
Watson Laidlaw & Co. Ltd.	xviii
Western States Machine Co.	xli
Joseph Westwood & Sons Ltd.	xlviii

FOR BUYERS' GUIDE SEE JULY ISSUE pp. xliii-lvii

N. A. HELMER
Member A.S.M.E.
CONSULTING ENGINEER
Representing
The Mirrlees Watson Company Limited, Glasgow, Scotland
Pott, Cassels & Williamson Limited, Motherwell, Scotland
POST OFFICE BOX 54—PLAINFIELD, N.J., U.S.A.

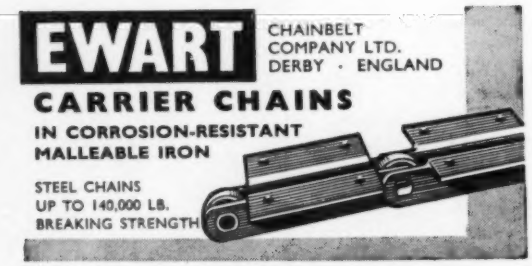
FONTAINE
Serving the Sugar Industry for more than 100 Years
Perforated Sheets of all Types.
Speciality: Small Perforations
FONTAINE & CO. GMBH. · AACHEN W.-GERMANY

E. C. MASSON Member A.S.M.E.
CONSULTING ENGINEER
CANE SUGAR MILLS & REFINERIES
Engineering & Construction — Improvements & Expansion
FACTORY AUTOMATION
P.O. Box 45-484 **MIAMI 45, FLORIDA** Telephone:
Cables: NOSSAM **U.S.A.** Highland 3-3025

SMALL ADVERTISEMENT RATES

Forty words or under—£1. 10s. 0d. sterling or U.S. $4.00 prepaid. Each additional six words or part thereof—5s. 0d. or U.S. $0.75. Box Numbers—charged as six words.

CHEMIST, Dutch, age 33 years, married, with eight years' experience in beet and cane sugar factories, of which the last two years in field laboratory for cane plantation. Familiar with crop logging, plant tissue analysis and statistics. Speaks fluent English and French. Letters to: W. W. Groenendijk, c/o J C. Groenendijk, Paasbergflat 56, Oosterbeek, Holland.



M. Sc. (Agric.), experienced over 20 years in sugar cane cultivation in all its aspects. Worked in various capacities in large factory owned sugar plantations. Seeks a suitable post as Plantation Manager. Write Box No. 420, *The International Sugar Journal Ltd.*

GUARANTEED

PROCESS PLANT

FROM STOCK

★ Stainless steel CLIMBING FILM EVAPORATOR by *Newman*, chamber stainless steel construction 3 ft. dia. x 4 ft. between flanges with bolted domed top, jacket with 1 in. connections, 6 in. flanges side vapour off-take and vertical tube 9 ft. 6 in. deep x 7 in. dia. with 2 in. connections.

★ Stainless steel VACUUM PLANT by *Oscar Krenz*, comprising vacuum Pan 48 in. x 8 ft. high with sight glass, manhole vacuum gauge, tester, thermometer, pressure gauge, with Calandria 48 in. dia. x 27 in. face to face with 192-2½ in. o.d. stainless steel tubes. Vacuum Pan with conical bottom with 3 in. outlet, connections, barometric condenser, etc.

★ Horizontal VACUUM DRYING PLANT by *Scott*, comprising horizontal cylindrical agitated drier 23 ft. long x 4 ft. i.d. with top centre feed inlet and bottom centre outlet with handwheel control. Jacket pressure 10 p.s.i., chamber pressure 10 p.s.i. agitator gear tubular type shaft 10 p.s.i. steam pressure. Drive by 10 h.p. motor through worm reduction gearbox. Including steel feed hopper with dust hood and worm conveyor in bottom, electric vibration unit, vertical inclined steel enclosed belt and bucket elevator, overhead steel holding bin, etc.

★ VACUUM OVEN, by *Francis Shaw*, mild steel welded construction, 5 ft. 2 in. wide x 8 ft. 9 in. long x 7 ft. high internally, heavy cast iron swing door each end having four corner wheel operated swing clamps, sight glasses, lamps and aircocks. Top and bottom flanged connections to internal, headers with swan neck connections to seventeen steam heated platens of welded construction 1¼ in. thick suitable 40 p.s.i. s.w.p. Daylight 3¾ in., effective platen width 60¾ in. (Three available).

★ Continuous horizontal TROUGH MIXER, *Gardner* type, 25 ft. 6 in. x 5 ft. x 5 ft. 8 in. deep trough constructed ½ in. mild steel welded plate with ribbed end plated extended to form support with two additional equally spaced cradles. Agitator shaft 24 in. dia. tube x 1 in. thick with forty-seven steam arms set at 90° with bolted on cast iron paddles 11 in. x 9 in. End discharge with adjustable slide. Counterbalanced hinged aluminium covers over mesh guards. Drive through coupling and worm reductions gear unit from 75 h.p. totally enclosed fan cooled motor with starter and switchgear, 415/3/50 cycles.

★ Twin roll buflovack DRIER by *Consolidated Products of U.S.A.*, rolls 100 in. x 32 in., suitable 100 p.s.i. w.p. Driven through reduction gearing from 5 h.p. 400/3/50 cycles motor. Fitted adjustable scraper knives, and aluminium hood. (Two available).

★ Stag KB.2 PULVERISER by *Edgar Allen*, manganese hammers and liners, 26 in. flywheels, six groove vee belt pulley. Feed box fitted counter balance dust flaps. 25/30 h.p. required to drive. Capacity 15/16 tons per hour passing ⅜in. limestone.

These are representative items from our wide range of new and reconditioned Plant. Comprehensive stocks also include:

Power Plant, Hydraulic Plant, Machine Tools, Contractors' Plant, Lifting and Mechanical Handling Equipment

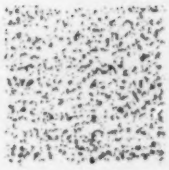
May we put you on our mailing list?

GEORGE COHEN
SONS & COMPANY LTD
ESTABLISHED 1834
LONDON, W.12 Cables: Omniplant, Telex, London
Telex No. 21288/9
600 GROUP

is yours a

DECOLOURISING

problem



. . specify

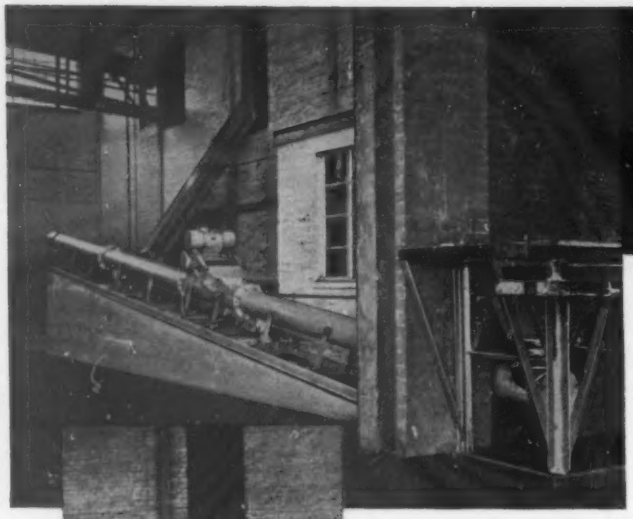
ACTIBON

THE HIGHLY ACTIVATED DECOLOURISING CARBON

IT'S CRYSTAL CLEAR

THE CLYDESDALE CHEMICAL CO., LTD.

SALES OFFICE
142 QUEEN STREET, GLASGOW, C.1.
Phone: Central 5247-8 *Grams*: "Cactus" Glasgow



'OWL'
VIBRATORY CONVEYORS
for the Sugar Industry

'Owl' Vibratory Conveyors are specially suited to many of the requirements of the sugar industry. This conveyor, installed at The British Sugar Corporation, Selby, is 10 in. dia., 40 ft. long, with a capacity of 25 tons per hour up an inclination of 7°, taking 3 h.p.

'Owl' Vibratory Conveyors are the most economical method of conveying any loose material, cold or hot, heavy or light.

Write for full particulars to :—

OWL ENGINEERING

A member of the JOHN THOMPSON GROUP

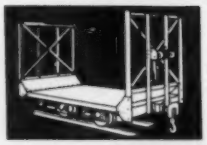
OWL ENGINEERING SUPPLIES LTD

TRIUMPH WORKS KIRKSTALL ROAD LEEDS 4 'Phone 3-3641

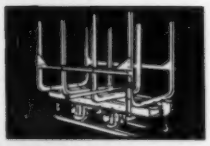
08

By road or rail... COLLECT *Cane* QUICKER

1 *ton car.*



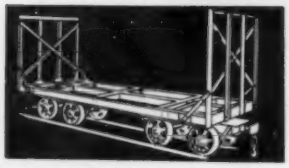
3 *ton car.*



5 *ton car for end loading.*

* *Send now for our catalogue section F.*

WITH **HUDSON** LEEDS CARS



3½ *ton capacity double bogie sugar cane car.*

ROBERT HUDSON LIMITED, P.O. BOX 55, LEEDS, ENGLAND. ***Cables Raletrux***

LONDON : 30-34 BUCKINGHAM GATE, S.W.1.

Light Railway Engineers, Trailer Makers, Fabricators

RH. 12

WHEN REVIEWING THE SUBJECT OF GEARS . . .

*

Whatever your transmission problems we design gears for any power—any speed. More than 50 years of specialised experience at your service.

*

Telephone:
West Drayton 2626 (4 lines)
Telegrams:
Roc. West Drayton

THE POWER PLANT COMPANY LIMITED

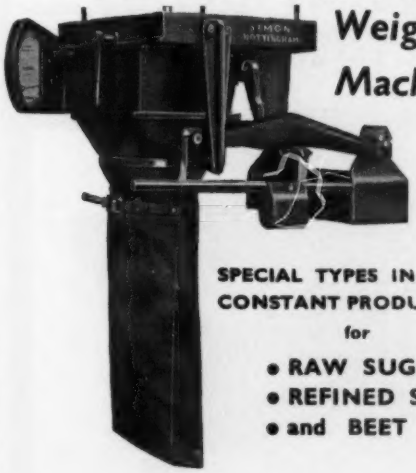
WEST DRAYTON, MIDDLESEX

CONTINUOUS BELT WEIGHER

for weighing whole beets or cossettes

Specially adapted for controlling the speed of cutting mills relative to weight for Continuous Diffusion Plants

Automatic and Sackfilling Weighing Machines



SPECIAL TYPES IN CONSTANT PRODUCTION for

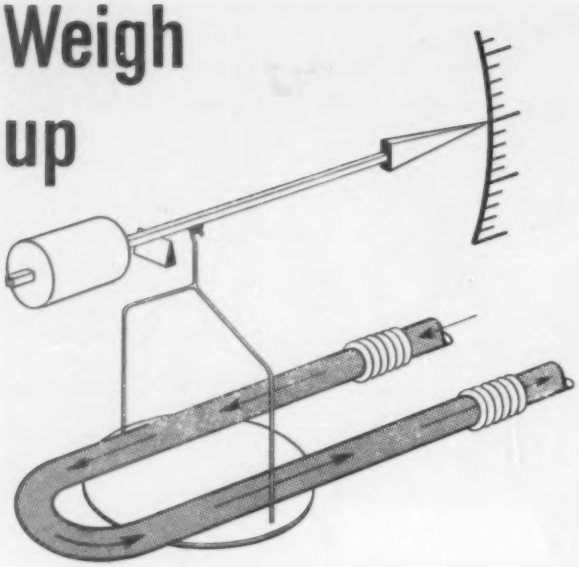
- RAW SUGAR
- REFINED SUGAR
- and BEET PULP

RICHARD SIMON & SONS LTD.

PHOENIX WORKS, BASFORD, NOTTINGHAM

Telephone: 75136-7-8 *Telegrams:* "Balance, Nottingham"

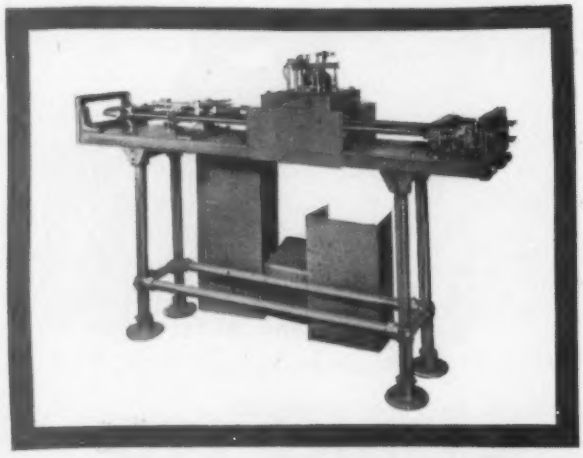
Weigh up



that Liquid Density problem

How *do* you detect critical changes in the density of the liquids passing through your pipelines? How *do* you measure that density accurately, continuously, and without interruption of regular flow?

The simple answer is—by "RM" Liquid Density Meter. This gives continuous instantaneous readings of the liquid in the pipeline. It will handle corrosive liquids without complaint and takes muds and slurries in its stride. It is a perfect team member in any automatic density control system.



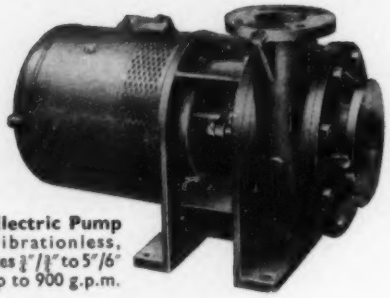
Full Technical information on request

ROTAMETER
FLUID MEASUREMENT AND CONTROL
FLOW-DENSITY-LEVEL

ROTAMETER MANUFACTURING COMPANY LIMITED
330, PURLEY WAY, CROYDON. *Tel.*: CROydon 3816 *Telex*: 24292
D17/302.

SAFRAN
REGISTERED TRADE MARK
PUMPS

PREFERRED



Unishaft Electric Pump
Robust, vibrationless, compact. Sizes ¾"/¾" to 5"/6" for duties up to 900 g.p.m.

FOR

Sump Pump
For a variety of de-watering purposes.

Float control switchgear incorporated.

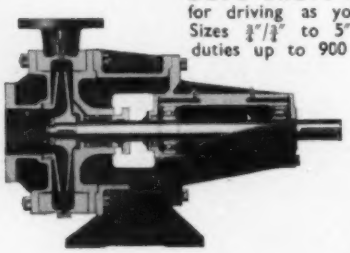
Typical duties at 1430 r.p.m.

Size 1" 15 g.p.m. at 17 ft./head.

Size 1½" 40 g.p.m at 14 ft./head.

PERFORMANCE

Bare-shaft units for driving as you will. Sizes ¾"/¾" to 5"/6" for duties up to 900 g.p.m.

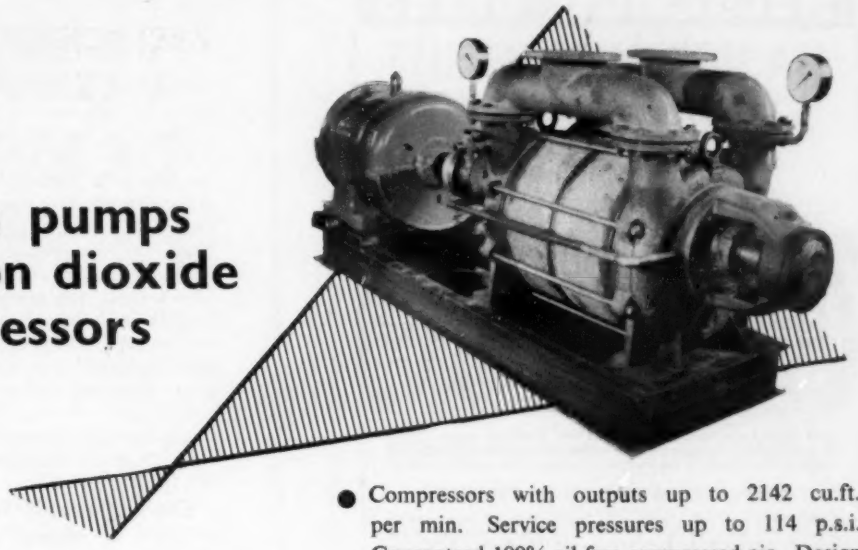


Specifications to suit a variety of applications

SAUNDERS VALVE COMPANY LIMITED
SAFRAN PUMP DIVISION
DRAYTON STREET WOLVERHAMPTON
Telephone: 25531

Sihi

Vacuum pumps and carbon dioxide compressors



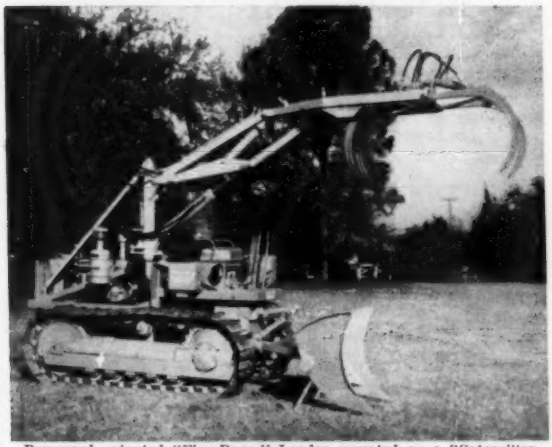
● Vacuum pumps with outputs up to 2142 cu.ft. per min., absolute pressure down to 25 m/m abs. or down to 5 m/m abs. when coupled in series with steam injector.

● Compressors with outputs up to 2142 cu.ft. per min. Service pressures up to 114 p.s.i. Guaranteed 100% oil-free compressed air. Design in various materials best suited for medium to be handled.

Siemen und Hinsch m.b.H., Itzehoe, West Germany

Dept 114, Lindenstr, 170/172 Cables: Sihi Itzehoe

SUGAR CANE LOADERS



Broussard patented "Flex-Boom" Loader mounted on a "Caterpillar D-4 crawler tractor, with push piler, for Puerto Rico.

Capacity 2000 lb/minute (Under Louisiana conditions), grab capacity (54 in. opening) 1500 lb., load clearance 12 ft., loading radius 10 ft. to 12 ft., boom swing, front to right, 100°.
The Broussard heavy duty tropical type loader is also available for installation on the Track-Marshall, International TD-9, Allis-Chalmers HD-6, John Deere 440 crawler, Fordson-Major and International B 450 as well as various USA wheel tractors.
Extremely simple in design with few wearing parts and with perfect operator visibility on both wheel and crawler tractor installations, the Broussard Loader may be easily installed at the destination on tractors already in hand and quickly removed at the close of the harvest.

Manufactured by
BROUSSARD MACHINE COMPANY
ST. MARTINVILLE, LOUISIANA

Export Division
LOGAN PERKINS—SUGAR MACHINERY
International Trade Mart, New Orleans, U.S.A.

We have sold our patented

SUGAR TABLET OR CUBE INSTALLATIONS

all over the world.

Cubes from dry granulated

The small machine with the big output!

Automatic packing equipment if desired

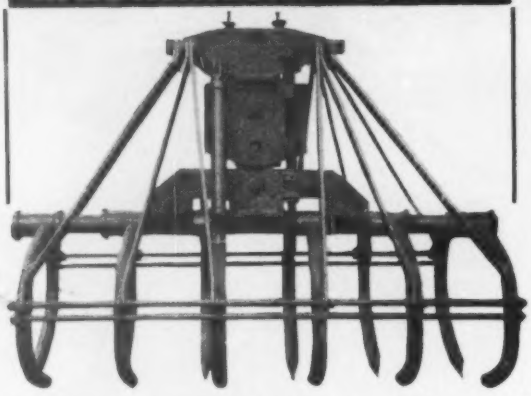
Very low capital outlay

Send for information to:

GOKA N.V.
MACHINE WORKS

Established 21 years
AMSTERDAM
HOLLAND
P.O. Box No. 130
Tel: 222255–222256
Telex: 14173 "Kagodam"
Cables "Kagodam"

MECHANICAL GRABS



This grapple is specially designed for handling sugar canes. It is of the twin-rope, self dumping type, but can be made to operate from single or multiple rope cranes. Send for full details.

JOSEPH WESTWOOD & CO. LTD.

Contractors to H.M. Government Departments, Crown Agents for the Colonies, British Railways (British Transport Commission), etc. etc., Bridge and Constructional Engineers, Manufacturers of Pressed Mechanical Grabs, Steel Troughing and Sheet Metal Equipment, Steel Stock Holders.

Napier Yard, Millwall, London, E.14. EASt 1043

Cables : Westwood, London
Grams : Westwood, Easphone, London

WESTWOODS

ZEITSCHRIFT FUER DIE ZUCKERINDUSTRIE

For the last 80 years the *ZEITSCHRIFT FUER DIE ZUCKERINDUSTRIE* (formerly *Die Deutsche Zuckerindustrie*) has been the authoritative German periodical for sugar technology and sugar economics. Each issue contains several original scientific and practical articles written by expert authors. The articles are prefaced by summaries in English and French. In addition, reports on the technical progress of sugar throughout the world and statistical data of world sugar economy are regularly published.

SAMPLE COPIES WILL BE SENT
FREE OF CHARGE ON REQUEST

Yearly Subscription Price : DM30.-
(postage included)

PUBLISHED EVERY MONTH

ZEITSCHRIFT FUER DIE ZUCKERINDUSTRIE
Berlin-Nikolassee, Germany
Lueckhoffstr. 16.

The Australian Sugar Journal

A MONTHLY JOURNAL issued by the AUSTRALIAN SUGAR PRODUCERS ASSOCIATION LTD.

Circulates throughout the sugar-producing districts of Australia.

It has in addition a substantial international subscription list.

Subscription Rates :

One pound (£1) (Australian) per annum.

For advertising rates, write :

G.P.O. Box 608J, Brisbane, Queensland.

GILMORE SUGAR MANUALS

MANUAL AZUCARERO DE CUBA
THE CUBA SUGAR MANUAL
(In Spanish). Published Annually—1959 Edition now available.

THE HAWAII SUGAR MANUAL
Published every Third Year—1957 Edition now available.

THE PUERTO RICO SUGAR MANUAL
(including Dominican Republic and Haiti)
Published every other year—1959 Edition now available.

THE LOUISIANA-FLORIDA SUGAR MANUAL
Published every other year—1959 Edition available.

Each $10.00 per copy (post paid)

★ *Detailed Technical Surveys on Agricultural and Manufacturing Practices of the Cane Sugar Industry*

GILMORE PUBLISHING CO., INC.
525 Audubon Bldg., New Orleans 16, Louisiana, U.S.A.

"Brasil Açucareiro"

OFFICIAL ORGAN *of the* BRAZILIAN INSTITUTE OF SUGAR & ALCOHOL
(INSTITUTO DO AÇÚCAR E DO ÁLCOOL)

A MONTHLY MAGAZINE containing complete news and specialized contributions on Brazilian and international sugar agriculture and industry.

Annual Subscription:

Brazil ..... Cr.$100.00
Foreign Countries ..... Cr.$150.00
Single Copies ..... Cr. $10.00
Back Copies ..... Cr. $15.00

Remittances must be made in the name of

INSTITUTO DO AÇÚCAR E DO ÁLCOOL
Praça 15 de Novembro, 42,
Rio de Janeiro,
BRASIL.
Caixa Postal 420.

THE SOUTH AFRICAN SUGAR JOURNAL

covering the

Sugar Industries of NATAL, ZULULAND, MOZAMBIQUE and EAST AFRICA

Since 1914

The *South African Sugar Journal* has presented planters and millers in the territories for which it caters with authoritative reviews of developments in all fields of sugar cane technology.

FREE SAMPLE COPY SENT ON REQUEST

Subscription and Advertising Rates available from

THE SOUTH AFRICAN SUGAR JOURNAL
P.O. Box 1209
London Assurance House, Smith Street, Durban, South Africa.
Telephone 25612

SUGAR NEWS

A MONTHLY JOURNAL DEVOTED TO THE INTERESTS OF THE PHILIPPINE SUGAR INDUSTRY

Published by:

THE SUGAR NEWS PRESS INC.

FEATURES

Results of research and experiments in fields and mills, and other important developments in the Philippine sugar industry of interest both to technical men and laymen ; sugar production, prices, and market news and statistics ; write-ups on other important and allied industries in the Philippines, etc.

SUBSCRIPTION

$7.50 U.S. Currency, per annum, post free *for U.S.A. and its possessions*

$10.00 U.S. Currency, per annum, post free *for other foreign countries*

WRITE FOR A FREE SPECIMEN COPY AND FOR ADVERTISING RATES.

Publishing Office:

417 Dasmariñas, 316 Doña Salud Building, Manila, Philippines.

CUBA SUGAR YEAR BOOK

New Edition (Spanish-English containing **SUGAR CENSUS** corrected to date, informative data and alphabetical index of Sugar Mills, giving situation, ownership, year founded, nationality, characteristics, total employees, yield (%), total cane ground, production and export of sugar, molasses, syrups, alcohol, cane brandy, aguardiente, rum.

Also lands owned and leased, colonos, days grinding, record and maps of rainfall, price of sugar and value of crops. Maps of Cuba showing ports, landings, distances, railways, roads, air communications, telegraph, cable and telephone connexions. Graphs with cane and cane products data. Bonded warehouses, taxes, and legislative measures enacted touching the industry.

Directories with over 3000 names and addresses of official and private organizations, business firms, cane growers (Colonos), department heads, producers, shippers, etc.

Foreign Section : Sugar production in U.S. and other countries (beet and cane). Imports and distribution of sugar and by-products in U.S. World demand and consumption, quotas, distribution, transport, etc.

$5 post paid

Edited by :

CUBA ECONOMICA Y FINANCIERA
POST OFFICE BOX 2549, HAVANA, CUBA
Teleph. M-3148 Lonja 441-442

Evaporators at the British Sugar Corporation Beet Sugar Factory at Cupar fitted with H & W 70/30 Brass Tubes. The evaporators are lagged with plastic lagging. (Photograph by courtesy of the British Sugar Corporation Limited).

H&W

BRASS TUBES

for

JUICE HEATERS

EVAPORATORS

VACUUM PANS

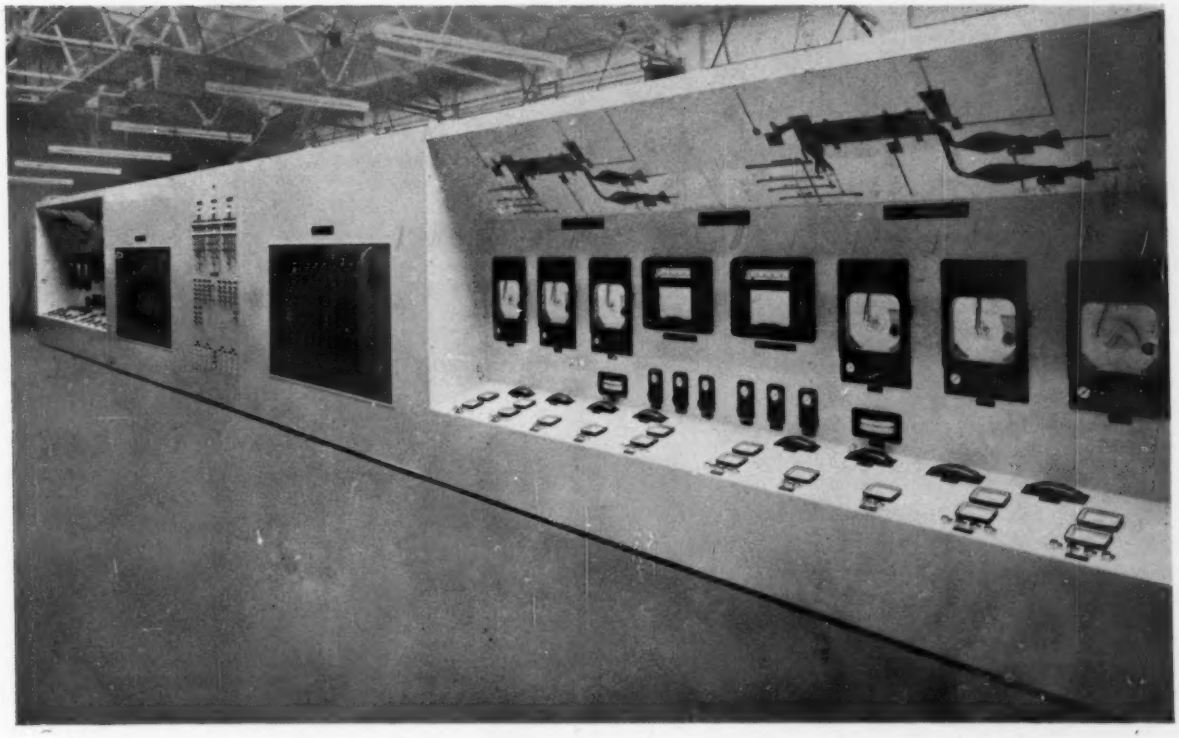
for quality uniformity and dependability

HUDSON & WRIGHT LTD. HALBERTON STREET, BIRMINGHAM 18

50, WELLINGTON STREET, GLASGOW, C.2.

TATE & LYLE
Choose ROTARY LOUVRE

One of Dunford & Elliott's latest and largest achievements for sugar refineries is the installation of four completely automatic Rotary Louvre Dryers and ancillary equipment at the THAMES REFINERY of TATE & LYLE LTD.—believed to be the biggest refinery in the world.



Control panel for Rotary Louvre sugar drying installation at the new Tate & Lyle Thames Refinery, designed and supplied by Dunford & Elliott. Photo by courtesy of Tate & Lyle Ltd.

Dunford & Elliott are also proud to announce having received an order to supply *Rotary Louvre* Sugar Drying and Cooling installations through Messrs. Vickers & Bookers Ltd. to two factories in the U.S.S.R.

Rotary Louvre Dryers and Coolers are used in leading industries throughout the world—as well as in the sugar industry—and frequently form part of such giant industrial projects as *Durgapur* in India.

DUNFORD & ELLIOTT
PROCESS ENGINEERING LTD.
Engineering of complete processes
DRYERS · COOLERS
ROASTERS

LINDARS AUTOMATION LTD.
AUTOMATION ENGINEERING

THERMIX INDUSTRIES LTD.
DUST CONTROL AND COLLECTION EQUIPMENT

DUNFORD & ELLIOTT
ENGINEERING GROUP

Headquarters: 143 Maple Road, Surbiton, Surrey
Telephone: Kingston 8916
Telegrams: Lindaresco, Telex, London.

I.S.J.

SUGAR BOOK DEPARTMENT

All books reviewed in this *Journal* may be obtained through our Sugar Book Department. Where no inclusive price is quoted in our review, 2s. 6d. should be added to cover the cost of packing and postage.

★ *Check your personal library against the list of basic books given below :*

		POST PAID
BASIC CALCULATIONS FOR THE CANE SUGAR FACTORY: *Eisner*	(1958)	**7s. 6d.**
PRINCIPLES OF CANE SUGAR MANUFACTURE : *Davies*	(1938)	**22s. 6d.**
CANE SUGAR AND ITS MANUFACTURE : *Geerligs* ...	(1924)	**32s. 6d.**
CANE SUGAR HANDBOOK (8th ed.) : *Spencer and Meade*	(1945)	**134s. 6d.**
SUGAR ANALYSIS (3rd ed.) : *Browne and Zerban*	(1941)	**183s. 6d.**
BEET SUGAR ECONOMICS : *Cottrell*	(1952)	**42s. 6d.**
SUGAR YEAR BOOK : *Int. Sugar Council*	(1958)	**11s. 0d.**
SUCRERIE DE BETTERAVES : *Dubourg*	(1952)	**62s. 6d.**
PRINCIPLES OF SUGAR TECHNOLOGY (Vol. I) : *Honig*	(1953)	**97s. 6d.**
(Vol. II): *Honig*	(1959)	**97s. 6d.**
TECHNOLOGY FOR SUGAR REFINERY WORKERS (3rd ed.): *Lyle*		**72s. 6d.**
LIGHT'S INTERNATIONAL SUGAR ECONOMIC YEAR-BOOK & DIRECTORY	(1959-60)	**55s. 6d.**
SYSTEM OF CANE SUGAR FACTORY CONTROL (2nd ed.): *International Society of Sugar Cane Technologists*	(1956)	**13s. 9d.**
HANDBOOK OF CANE SUGAR ENGINEERING. *Hugot,* translated by *Jenkins*	(1960)	**172s. 6d**

The above prices include postage and packing.

Terms are strictly cash in advance.

Our Bankers are : Barclays Bank Ltd., 3 Great Tower Street, London, E.C.3.

SUGAR BOOK DEPARTMENT, International Sugar Journal, Ltd.

Central Chambers, The Broadway, London, W.5.

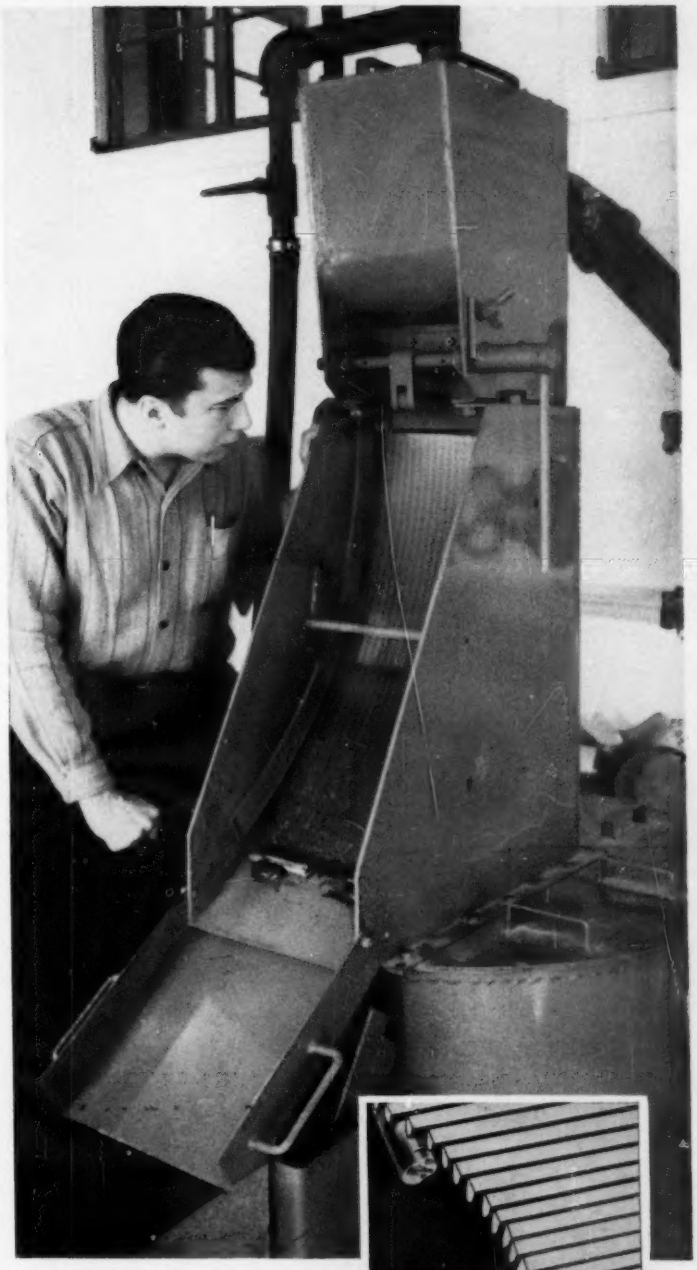
A NEW WAY TO SEPARATE FIBER FROM CANE JUICE...

The DORR-OLIVER DSM® SCREEN

Latest addition to Dorr-Oliver's line of sugar processing equipment is the DSM Screen. A radical departure from normal practice, the DSM offers many advantages over conventional screens. It consists of a stationary housing equipped with a concaved wedge bar type screen with provisions for introducing feed and withdrawing fiber and juice.

In operation, juice enters the feed box and is fed by gravity tangentially onto the upper surface of the screen. Flowing down the concave surface at right angles to the openings between the wedge bars, the juice passes through these apertures and is collected in the screen box. Fibers pass down the screen surface and are dewatered prior to discharge.

For further information on the DSM Screen for separating fiber from cane juice, write to Dorr-Oliver Incorporated, Stamford, Conn., U. S. A.



A DSM Screen installation showing simplicity of design and overall compactness.

Closeup showing detail of wedge bar design.

ADVANTAGES OF THE DORR-OLIVER DSM SCREEN

- Wedge bar design promotes high screening efficiency and essentially a non-blinding screen.
- The DSM is a compact unit which can be installed with a minimum of effort.
- Stationary design with no moving parts means low operating cost and minimum maintenance.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

IMMENSE STRENGTH

FLETCHER Mill Rollers are made from "Atlas" metal, to bear the strain of constant use. This hard, open-grain iron—cast in our foundry under close metallurgical supervision—remains rough, hard and coarse from surface to centre.
For more than a century FLETCHER have specialised in the design and manufacture of process plant for the sugar industry. It is installed in every major sugar producing country in the world.

CAST IN 'ATLAS' METAL

FLETCHER

modern mill rollers

GEORGE FLETCHER & CO LTD
MASSON WORKS LITCHURCH LANE DERBY ENGLAND
GRAMS: AMARILLA DERBY *PHONE: DERBY 45817*

Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at Central Chambers, The Broadway, London, W.5. Entered at the New York Post Office as Second-Class Matter. Registered for transmission by Canadian Magazine Post.
PRINTED IN GREAT BRITAIN.